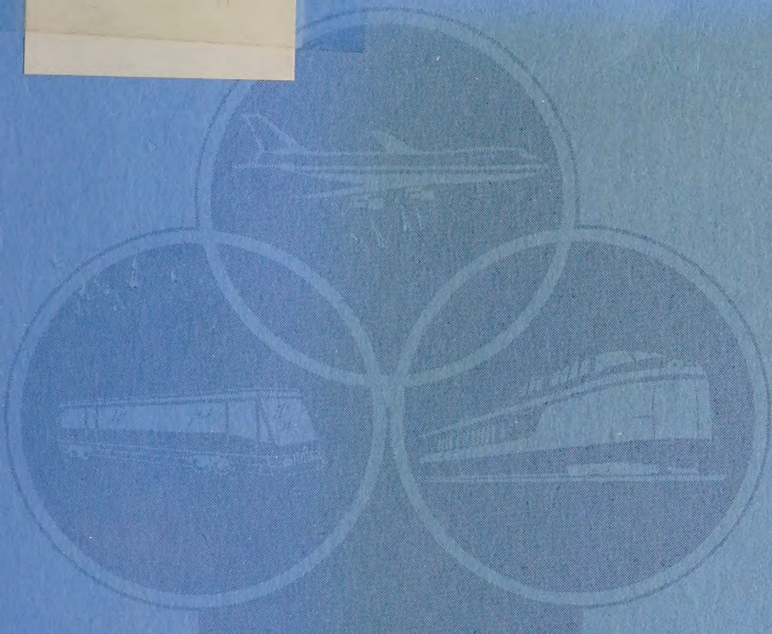
PHASE II A REPORT



SACRAMENTO STOCKTON SAN FRANCISCO BAY AREA CORRIDOR STUDY

PREPARED FOR

BUSINESS & TRANSPORTATION AGENCY, STATE OF CALIFORNIA
SENATE, STATE OF CALIFORNIA
UNITED STATES DEPARTMENT OF TRANSPORTATION
METROPOLITAN TRANSPORTATION COMMISSION
SACRAMENTO REGIONAL AREA PLANNING COMMISSION
SAN JOAQUIN COUNCIL OF GOVERNMENTS

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April 1, 1974

Policy, Steering and Technical Resource
Committee Members

Gentlemen:

This Phase IIA report presents the alternative intercity passenger transportation improvement programs under study as part of the Sacramento-Stockton-San Francisco Bay Area Corridor Study. The 16 alternatives, their service rationale, major economic and environmental impacts and capital costs are described. Institutional and implementation issues are raised and the potential role of the State in intercity public transportation is outlined.

The Phase IIB Report to follow shortly will present the patronage potential and operating costs associated with these alternatives. A sensitivity analysis of patronage will be included. An accompanying Phase II Summary Report will complete the Phase II technical work by the Consultant team.

This report has been developed by the Consultant team lead by Alan M. Voorhees & Associates working closely with the State, Regions, and the U.S. Department of Transportation. However, since it covers a broad range of issues and alternatives, careful review of this material by all participants is necessary to permit focusing on the most promising alternatives in Phase III. We look forward to your comments, criticisms and suggestions towards this end.

Very truly yours,

Charles P. Sweet, Jr.
Project Manager

Please note: Material presented in this report represents the findings and judgment of the Consultant Team and does not necessarily represent the views of the Policy and Steering Committees.

I.

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I. APPROACH TO IMPROVEMENT PROGRAMS

INTRODUCTION

The objective of this study is to decide whether, how, and when to serve the increasing intercity public transportation needs of those who are or will be living and working in the study region, and how to do so at a reasonable cost and in a manner which achieves a satisfactory balance between improved transportation service, socioeconomic effects and environmental impacts, and the cost of providing service.

Phase I of the study developed a general background, including a snapshot of alternative futures for 1980-1995 with their travel implications. Major policy issues were outlined, and a range of intercity transit improvement programs were identified for further elaboration. A generalized evaluation approach was established, including a first round approximation of patronage and related socioeconomic and environmental effects. The need for a clear policy framework at the state and regional level for intercity public transportation was also revealed.

During Phase II, the study has been concentrating in 6 major areas:

- Developing improvement programs to a level sufficient to define their major characteristics-routes, stops, technology, performance, operating configuration
- Forecasting the travel demand and patronage expected for each alternative with associated travel benefits as well as capital and operating costs
- Determining major economic and environmental impacts associated with the construction or operation of the alternatives
- Forecasting alternative future regional socioeconomic development patterns as a framework for evaluation
- Developing staging and implementation issues, including funding sources
- Indicating institutional requirements to plan, design, construct, and operate the alternatives.

This is the first of two reports summarizing Phase II work. Together with the second report, Patronage and Evaluation, material has been developed to permit the Policy and Steering Committees to select the more promising alternatives for the last phase of the study. This final phase will develop an action plan designed to launch the process of intercity public transportation improvement.

Section I of this report summarizes the rationale for investigated intercity transportation alternatives to the automobile. The transit improvement programs are introduced, including their system components, routes, stops, and frequencies.

Section II describes the improvement programs themselves. This description includes an outline of the technology and its advantages and shortcomings, the proposed operating concept, the planned routes and capital costs and compares the levels of service.

Section III focuses on the environmental impacts associated with each improvement program, including energy and noise. It also discusses the possible economic impacts at the regional, corridor and local scale.

Section IV describes the institutional structure required to develop intercity public transportation service and the major implementation issues associated with the alternative improvement programs.

ALTERNATIVES TO THE AUTOMOBILE FOR INTERCITY TRAVEL

The private automobile is expected to remain the dominant mode of intercity transportation in the corridor over the time horizon of this study (20 years). At present, it carries 95 percent of the intercity trips in the study region. For trips of less than 100 miles, but beyond normal congested commute areas, it has the built-in advantages of a technology which can be operated at will by driver-passengers in total privacy with complete environmental control. It provides almost door-to-door service without transfer in most cases. Large public and private investments in automobile infrastructure--interstate highways, local streets, garages, gas stations--as well as in developing the technology itself, support this service. The continued superiority of the automobile for intercity travel depends on:

- Relatively uncongested freeways
- Large percentage of trip length on freeways
- Adequate, convenient, cheap parking

- Relatively high auto occupancy (over 2)
- Efficient, nonpolluting propulsion and an available energy supply
- Ability to purchase
- No equally attractive transit alternative in terms of travel time, cost convenience, or comfort

Indeed, the patterns of urban development and lifestyle of this region have been structured around the automobile in the past 30 years. Rising real incomes have been shown in the past to be strongly correlated with increased car ownership in the 9-county Bay Area, with incomes expected to nearly double in the next 25 years.

The increased cost of energy is expected to result in a change in both automobile weight and power toward more efficient and smaller vehicles. Nonetheless, the increasing cost of fuel and the diminished comfort and security of small cars on long trips coupled with speed limit changes may establish a climate more favorable to an alternative mode. The transit systems investigated represent a search for that alternative mode for trips beyond the normal commute distance, but less than 100 miles long. A competitive mode must offer superior service through some combination of speed, cost, convenience, comfort, safety, etc., if it is to attract a market which also has access to an automobile.

A clear mandate of this study is to investigate the feasibility of alternatives to the automobile which--while it will remain the predominate mode in the region may not continue to dominate all travel purposes. The search is to identify advantages offered by different transit improvements toward meeting both transport and non-transport objectives including:

- Availability of a higher level of intercity transportation service in terms of travel time, reliability, comfort, and convenience
- Reduced dependency on the automobile and achievement of a balanced transportation system
- Decreased necessity to expand highway system
- Reduction in energy use
- Reduction of environmental impacts associated with the growth in automobile traffic, such as noise and air pollution and urban sprawl

- Management of a multimodal transportation corridor, including coordinated transportation and land use development

- Closer ties between major regional centers for increased economic integration.

Building on Phase I results, a broad range of transit solutions have been developed, ranging from bus to high speed trains to tracked air cushion vehicles. Improvement programs developed are in 3 categories: (1) existing technology (conventional auto and express bus) where changes in operating policies are the focus of attention; (2) installing existing technologies and existing equipment (BART); (3) and installing relatively new or independent technologies (tracked levitated vehicles and short-haul air).

Express Bus -- Phase I tests showed that buses might attract increased ridership in the future if the service and coverage were improved. The simple line-haul alternatives tested during Phase I were judged not to be fully exploiting the multiple route capability of buses. New routes and park-ride stops were added in planning the Phase II improvement program.

BART Rapid Transit -- Alternatives based on BART technology were tested during Phase I. These alternatives were developed further during Phase II, and a Stockton-oriented alternative was added. Phase II conceptual engineering and operational review revealed two major shortcomings to this alternative. First, current BART technology is designed for 80 mph top speed with acceleration/deceleration characteristics appropriate to urban applications. Equipment offering higher speed could be developed, if it offered significant advantages, but a major re-engineering effort would be required for some of the vehicle components. Second, continuous non-transfer operation between Daly City and Sacramento or Stockton is only possible in off-peak hours due to differences in train consists, scheduling, problems in train make-up (coupling, testing, etc.), and headway restrictions.

Rail -- The rail alternatives tested in Phase I were compromise alternatives representing a middle ground level of service between that which can operate on existing versus new tracks. For Phase II, testing rail alternatives were divided into two separate technologies--one 90-mph conventional diesel-electric designed to operate on existing track with limited upgrading and new controls; and one 120-mph turbine-hydraulic "tilting body" requiring new tracks and controls. In addition, a series of route/stop combinations were developed.

The Tracked Levitated Vehicle (TLV) -- A transit system using air suspension is based on U.S. DOT's Phase II bi-directional entrainable urban tracked air cushion research and design programs. However, in the present phase of this study a variable two-speed linear induction motor is assumed as propulsion obtaining a maximum speed of 200 mph which moves beyond the current 150 mph capability being developed for the "urban" TACV. The Phase I alignment from Oakland to Sacramento has been modified in keeping with the limitations developed for this technology and is assumed to be a section of what may ultimately be a "west coast corridor" system.

Short Haul Air -- During Phase I tests, short-haul air systems did not attract patronage in the same scale as the other ground alternatives, even with the addition of a San Francisco and Concord airport. As a result, testing during this phase added an "advanced technology" alternative with an expanded number of port options. Attention during Phase II has been on the potential for service increase with decrease access time implicit in a greater number of ports. No attempt has been made to actually locate these ports or to develop original cost data on the technology or facilities. Concepts of public support will also be added to this alternative.

Over-the-Water -- Over-the-Water (OTW) technology was given preliminary consideration as a possible major intercity passenger transportation candidate. However, in the context of a search for an alternative for the automobile in the study area, an OTW system has several limitations:

- Only a small proportion of the total SSSBACS intercity market is from downtown San Francisco to downtown Sacramento.
- Waterways do not offer as direct a route in terms of travel distance as do land routes.
- Terminals cannot be located directly in downtowns.
- Current speeds of 30-50 mph are not competitive with ground transportation systems.
- No cheap, reliable, fast, comfortable OTW technology currently exists. Major technological problems exist for speeds over 60 knots associated with propulsion, hulls, skirts, air containment, and controls.
- Safety, noise and comfort, weather reliability, ecological impacts will cause both practical and legal problems.

These issues, in combination with the planning consideration, do not indicate OTW as a high payoff technology for this particular application.

Phase II has concentrated on the conceptual planning and engineering of these improvement alternatives to serve the major intercity travel needs of the region. Figure 2 lists the technologies studied, their major features, maximum speeds, and areas of chief technical concern. The performance and geometric criteria assumed in developing the improvement programs with these systems are shown in Figure 2.

The systems selected offer a wide range of performance and service characteristics. Figure 3 indicates their top speeds as developed within the study area given--certain stops and operational characteristics. The range is from express bus, usually limited by speed limits of 65-70 mph (currently 55 mph) on the freeways, to TLV at 200 mph and short-haul air at more than 300 mph.

The average speed of the ground systems falls into three general ranges: bus, BART rapid transit technology, and diesel electric rail equipment on upgraded rail cluster in the 58-75 mph area. Turbine-hydraulic (turbotrain) rail vehicles on new track average close to 100 mph. Tracked Levitated Vehicle technology is capable of 160-170 mph average speed. All of these averages are sensitive to the number of stops included on the route, and the length of the average speed band indicates the response to the number of stops (2-4) that occur within the routes under consideration.

The slope of the speed/distance curves indicates the acceleration for each technology. The number of stops planned for the faster systems has been related to their acceleration capabilities and top speeds by planning fewer stops and greater distances between stops in an effort to take advantage of the investment in speed in terms of time savings.

THE IMPROVEMENT PROGRAMS

The transportation improvement programs developed during this phase are alternative mixes of technology, route, stops, operational configurations, and feeder distribution systems, serving different city combinations with the study region. Institutional arrangements appropriate to each mix have also been investigated. The focus of this study on intercity transportation in the region implies, as a minimum, the improvement of access between the three major metropolitan areas in the region--San Francisco/Oakland, Sacramento, and Stockton. In respect to the smaller cities within the region, the broad variation in their size and wide range of distances between them

FIGURE 1

IMPROVEMENT PROGRAM SYSTEMS

SYSTEM	MAJOR FEATURES	MAXIMUM SPEED	MAJOR TECHNICAL CONCERNS
Express Bus	Express lanes, existing roads, station adjacent to road ("Pads")	70 mph	Operation on grades Traffic interference Pollution
BART Rapid Transit	Wide gauge, steel wheel D-C series motor third rail power	80 mph	Train Control
Conventional Train on Upgraded Tracks	Diesel-electric (tilting body optional)	90 mph	integration with existing operations Reliability Maintenance
Turbo-Train on New Tracks	Turbine/hydraulic tilting body, banking	120 mph	Mechanical transmission Reliability Maintenance
Tracked Levitated Vehicle	TACV or MAGLEV, third rail, 3-phase AC	200 mph	Air resistance in tunnels Air motion at wayside
Short-Haul Air	Shorter take-off and landing vehicles	300 mph+	Noise Port location

FIGURE 2

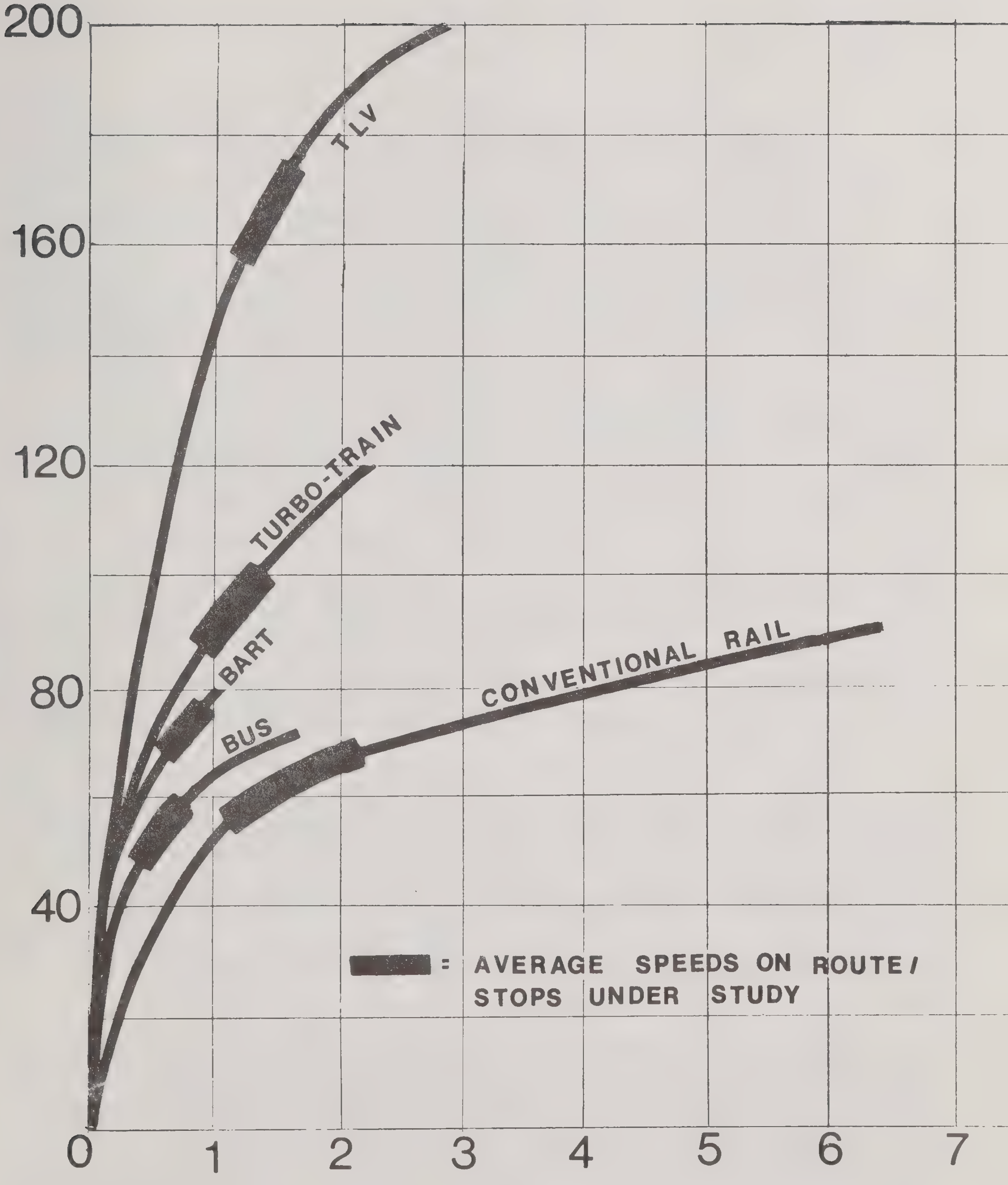
PERFORMANCE AND GEOMETRIC CRITERIA

	BUS	CONV. RAIL	BART	TURBO TRAIN	TLV
PERFORMANCE					
Maximum Velocity - mph	70 4)	90	80	120	200
Average Acceleration - mphps	0.6	0.25	1.5	1.0	2.3
Average Deceleration - mphps	2.2	2.0	2.4	1.9	3.1
MAXIMUM SUPERELEVATION	0.10 ft/ft.	0.5 ft.	0.5 ft.	0.5 ft.	.176 ft/ft
VERTICAL CLEARANCES	14'-6"	23'-0"	13'-6"	15'-0"	14'-6"
HORIZONTAL ALIGNMENT					
Minimum Radius (Main Line)-Ft.	NA	575	500	575	950 3)
Radius at Max. Operating Speed-Ft.	1900	5200	3400 1)	3750	15,200
VERTICAL ALIGNMENT					
Max. Gradients in Line Sections	6%	2%	3%	2%	2%
Length of Vertical Curves at Max. Operating Speed --ft.					
Sag at 1% Gradient Difference	400	2000	250 1)	400 2)	600 2)
Sag at 4% Gradient Difference	800	8000	500 1)	800 2)	2200 2)
Crest at 1% Gradient Difference	400	1000	250 1)	400 2)	600 2)
Crest at 4% Gradient Difference	1600	4000	1000 1)	800 2)	2200 2)

1) BART Values for Optimum Conditions
2) Minimum Values Based on 0.05g Vertical Acceleration
3) Assuming a Minimum Velocity of 50 mph
4) Not limited by fuel conservation speed limits

Note: mphps = miles per hour per second.

Figure 3



DISTANCE - MILES

Performance Curves

suggested that no strict definition or urban versus intercity travel can be devised. Therefore, two criteria were applied:

- Cities included for service must not be suburbs within a metropolitan area whose economy and travel patterns are tied up in a commute relationship

- Cities included must be outside the existing or projected range of urban transit--bus or rapid transit

No detailed consideration has been given to transit solutions to the growing recreation travel demand between Sacramento and the Bay Area to the Sierra recreation areas. Messy (outdoor-oriented) and Dressy (indoor-oriented) recreation travel is growing rapidly and is almost totally by auto and bus. Through charter arrangements and special schedules, bus service meets seasonal peaks. No technical break-throughs are evident that would provide service, reduction in travel time, or flexibility. Consideration is given, however, to transfer capabilities in Sacramento. At the present time, Amtrak trains stop at Truckee; charter "fun trains" are run to Reno. In view of the growing demand for recreation travel, it may be advisable to design the Sacramento station track approach to permit transit to switch to existing Southern Pacific mainline for continuing on to Truckee or Reno should such regular service be warranted. Tilting body suspension and improved power to weight ratios of two trains may permit a reduction of the current three and one-half hour Amtrak schedule between Sacramento and Truckee. Improvements in track alignment will be very expensive for further reductions would be very expensive.

The alternatives are conceived of within an evolutionary context. That is, progressive service improvements can be added by either upgrading intercity transit service in terms of staged increments in level of service or extending it geographically to a progressively larger number of cities. In addition, one type of system can be installed as appropriate within one subcorridor while a different technology is used in another subcorridor. Certain technologies (TLV and air) will not be available for several years and must be thought of as a later stage of development.

Some of the improvement programs can be combined and staged such that investment [illegible] can introduce successively greater improvements within a given subcorridor--building on the habits and facilities that are part of an earlier improvement.

Routes

During Phase I, a number of routes were examined. Existing urbanized areas in the developable land areas are along historical transportation corridors where the automobile replaced trains, boats, and horse-drawn wagons. Since regional and local plans envisage development contiguous to those developed areas in an effort to improve efficiency and protect the environment, most of the route studies made use of the existing transportation corridors. Alternatives have been planned around the use of rail and highway rights-of-way. Selection was based on:

- Avoidance of encouraging greater suburban sprawl or consuming environmentally or agriculturally valuable land following the goals of regional and local plans
- Close ties to local rail transit or bus routes to serve as feeder-distribution systems in urban areas
- Desire to stay in established transportation corridors in order to establish a visible "multimodal corridor" system
- Reinforcement of local and regional land use plans in respect to development
- Minimum environmental or community disruption
- Maximum potential using existing transportation rights-of-way or existing transportation facilities to minimize costs
- Best competitive location to attract drivers out of automobiles.
- Connections to Travis Field as a fourth major jetport serving the Bay Area

The corridors investigated were restricted to those connecting the major travel generators--the Bay Area, Sacramento, and Stockton. Connecting routes were sought which would at the same time serve intercity travel among the smaller cities, as well as between them and the three major cities. Routes that did not serve existing urbanized areas did not develop large patronage during Phase I tests and, in addition, would tend to induce development in unsuitable areas not called for in regional and local plans. Such routes were not tested further during Phase II.

Five major routes (subcorridors) were identified which met most of the criteria described above. These included:

- The I-80 subcorridor between San Francisco and Sacramento. This corridor is the historical connection between the center of commerce and the capital and is the major urbanized corridor in the study region.

- The little used Sacramento Northern right-of-way to Travis AFB/Fairfield as a subvariant connecting eastern Contra Costa County to the I-80 corridor, emphasizing Travis service.[1/]

- The Route 4/Santa Fe corridor provides the most direct connection from the East Bay to Stockton, building on BART service into Contra Costa County.

- The Route 580/680 corridor provides a South Bay to Stockton connection via Tracy building on BART service to San Leandro.

- The Southern Pacific/I-5 corridor providing a direct Stockton-Sacramento connection via Lodi.

Stops

The cities served were selected for testing in response to the same criteria used in route selection. In addition, however, station spacings were chosen with respect to the trade-off between total number of stops (coverage) and the desire to maintain the top speed potential of the system and its acceleration/deceleration characteristics. This implies a longer station spacing for the higher speed technologies in order to avoid "diluting" their long distance trip potential. At the same time, preliminary patronage figures from Phase I indicated that intermediate stops, such as Vallejo and Fairfield, would add substantially to the ridership potential of all systems. The final route/stop selection for testing in this phase were composed in recognition of this trade-off.

The intercity route-stop-schedule combinations have been conceived so as not to compete with existing commuter services. Commute oriented service has not been a primary goal of the systems being planned although the higher speed systems will make some commuting possible from locations that are currently beyond the coverage of existing urban transit.

1/ Southern Pacific is currently negotiating for trackage rights from their mainline to Collinsville.

Figure 4 lists the improvement programs, their terminal and intermediate stations and the route length. Station locations were chosen in order to maximize local access to and from the station often in conjunction with locations where highways crossed the proposed alignment as in Fairfield and Davis. Some stations are "downtown" oriented (Fairfield, Vallejo, Sacramento). Others were located for their park-ride potential (nearness to major arterials or highways) or modal interchange possibilities such as the BART-oriented cross-platform transfer stations at Richmond, El Cerrito del Norte, and West Pittsburg or the Travis Air Terminal stop serving the Fairfield area.

Since different mixes of station stops were selected for preliminary costing and patronage evaluation, it is possible that economic impact evaluation will suggest altering the mixes selected during this phase.

Feeder Distribution System

The importance of convenient access between trip origin or destination and the intercity line-haul component of the intercity trip is increasingly recognized as of critical importance to the preparation of any transit mode. Particularly for intercity line-haul trips of less than one hour duration, access to and from the system plus waiting time may take longer than the line-haul portion of the total trip. The poor feeder-distribution characteristics of existing intercity modes help explain their lack of attractiveness compared to the automobile.

The access time component of perceived delay in a total door-to-door trip is greater than for the line-haul portion of the trip for bus, conventional rail, and BART Continuation. It is apparent, therefore, that a greater increase in the attractiveness of the overall service is achieved for each minute of waiting, walking, or access mode time reduction than for each minute of line-haul time saved.

Recognizing this fact, four approaches have been incorporated into the improvement alternatives to reducing access time:

- Increasing access mode speeds -- The urban location of most terminals and stations makes this extremely difficult since access modes are both multipurpose and/or on fixed schedules in mixed traffic.

FIGURE 4

IMPROVEMENT PROGRAMS

Alternative	Terminal Stations	Intermediate Stations	Length Miles
Express Bus-Bay Area/Sacramento (Bus E)	Several Routes	Differ'	70-90
Express Bus Bay Area/Stockton (Bus S)	San Leandro Stockton Bus Station	Livermore Tracy	63
Express Bus-Stockton/Sacramento (Bus S)	Stockton Bus Station Sacto Bus Station	Lodi	50
Conventional Rail-Oakland/Sacramento (Rail RE)	Oakland 16th St. Exist. S.P. Railroad Station Sacramento	Richmond Martinez Fairfield Davis	57
Conventional Rail-Antioch/Stockton (Rail AE)	Antioch BART Station, Exist. Santa Fe Railroad Station Stockton		32
Conventional Rail-Stockton/Sacramento (Rail AE)	S.P. Station Stockton S.P. Station Sacramento	Lodi	48
Conventional Rail-W. Pittsburg/Sacramento (Rail PE)	W. Pittsburg BART Station, S.P. Station Sacramento	Travis Davis	55
BART Continuation-W. Pittsburg/Sacramento (BARTP)	W. Pittsburg BART Station, 2nd & I, Sacramento	Travis Davis	55
BART Continuation-Richmond/Sacramento (BART R)	BART Station at Richmond 2nd at I in Sacramento	Pinole Vallejo Cordelia Fairfield Davis	75
Turbotrain-W. Pittsburg/Sacramento (Rail PN)	W. Pittsburg BART Station, 2nd & I, Sacramento	Travis Davis	55
Turbotrain-Richmond/Sacramento (Rail RN)	BART Station at Richmond 2nd at I in Sacramento	Vallejo Fairfield Davis	75
Turbotrain-Richmond/Sacramento (Rail RN Hwy)	BART Station at Richmond 2nd at I in Sacramento	Vallejo Fairfield Davis	77
Turbotrain-Antioch/Stockton	BART Station Antioch, Santa Fe Station Stockton		33
Turbotrain-Stockton/Sacramento	S.P. Station Stockton S.P. Station Sacramento	Lodi	46
TLV (TACV)-Oakland/Sacramento	Oakland Cypress St. at 7th St. Sacramento Ave. Interchange at I-880	Fairfield	77
Short-Haul Air	Several		80-90

- Increasing access mode availability -- Fixed route local bus and rail transit frequency should be oriented toward minimizing waiting times for both feeder and distributor purposes. This relies primarily on the urban transit network. Special routes may be advisable as well.

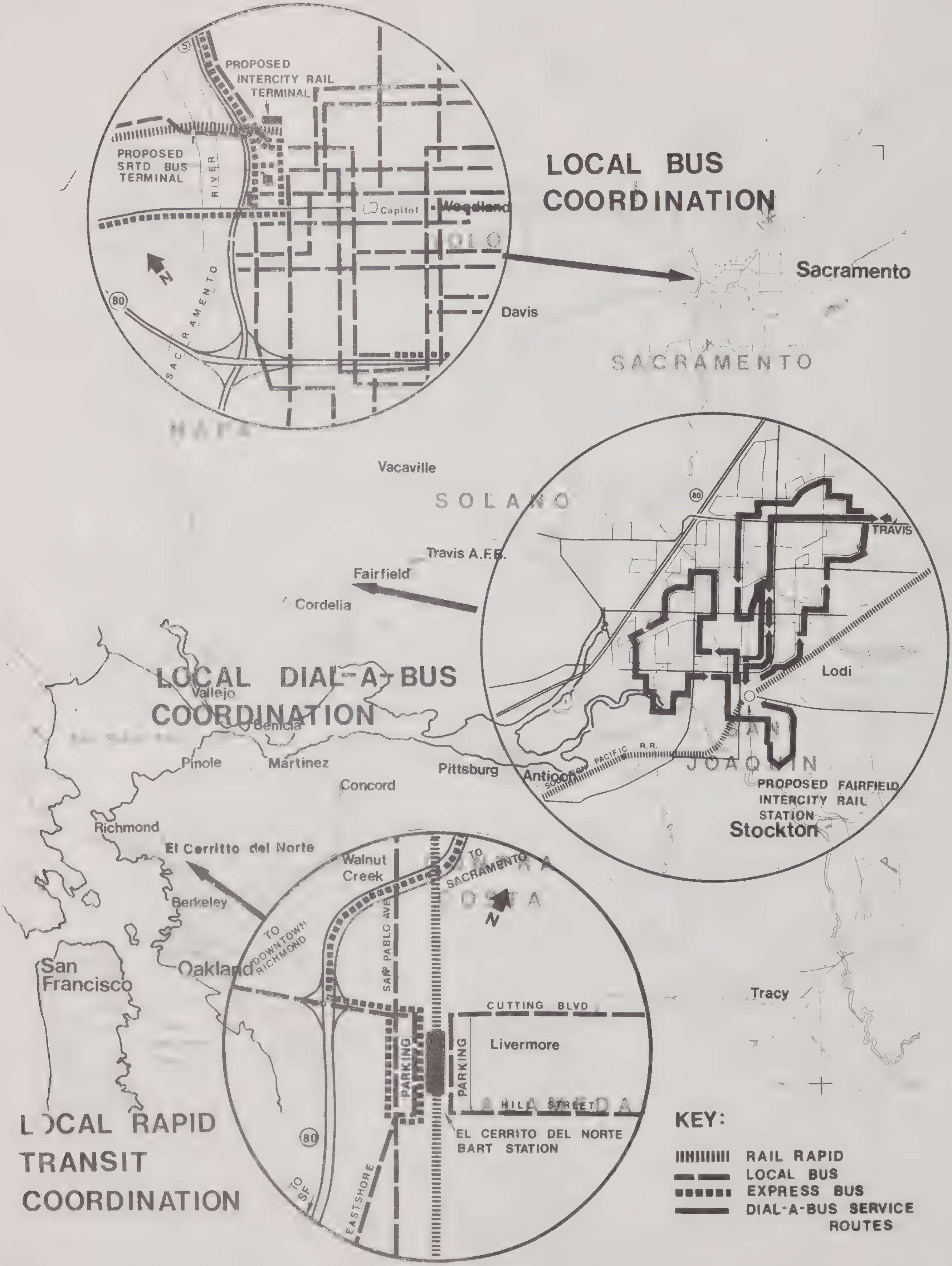
- Increasing dispersion of terminals -- For buses, this has suggested multiple route strategy with a variety of terminals, particuarly in the Bay Area. In Sacramento and Stockton both downtown and suburban park-ride terminals are considered.

- Reduce uncertainty -- Much of the waiting time required to "catch" a line-haul mode is cushion-time to assure reaching the station before line-haul departure. A demand-actuated local transit system (dial-a-bus) can reduce waiting time at the home end of a trip by making it "usable time" and also be programmed to meet a certain line haul departure schedule.

Special attention has been given to interfacing the new line-haul system alternatives with the exisiting and projected local transportation systems. In addition, attention is given to the need to create new demand-responsive access transit in small cities and low density areas.

Frequency of Service

Service frequencies discussed in this report are initial assumptions necessary for travel forecasting, comparative evaluation, and capital cost estimating. The frequencies are based on Phase I manual county-to-county travel forecasts. Patronage Forecasts developed using a travel demand model in the Phase II Patronage Forecasting and Evaluation Report will be used to modify these frequencies.



SSBACS

SACRAMENTO ▪ STOCKTON ▪ SAN FRANCISCO BAY AREA ▪ CORRIDOR STUDY

FEEDER-DISTRIBUTOR EXAMPLES

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AMV
DRA
EDAW
KE

Figure 5

II.

II. IMPROVEMENT PROGRAM DESCRIPTION

The following section describes the various improvement programs based on the technologies, routes, and operating concepts discussed in Section I. Discussions of each separate improvement program include a description of existing service offered by that technology, if any. It then points out the key features of the route/stop/operational mix designed to maximize on that technology's potential for intercity service. Proposed alignments are described, along with conceptual engineering based cost estimates. The level of service offered in terms of station-to-station train time is presented. These improvement programs have been composed for service, cost and impact evaluation. The degree of specification has been designed so that comparative cost estimates may be made, patronage forecast and key implementation problems identified. The Patronage and Evaluation Report contains an operating cost/revenue analysis.

While for each of these programs countless variations may be developed, the focus has been in developing logical improvement programs that will highlight differences so that key policy decisions can be made toward improving intercity transportation.

EXPRESS BUS ALTERNATIVE

Private bus service today constitutes the bulk of the existing intercity transportation service in the study region. The study area service is largely under a Greyhound Lines-West franchise, regulated by the State Public Utilities Commission.

Present Service

The Sacramento-San Francisco/Oakland Corridor is the most heavily served and patronized in the entire Greyhound system west of Milwaukee. This service includes:

- 13 San Francisco-Sacramento daily nonstop expresses, each way
- 12 Oakland-Sacramento daily nonstop or one-stop (Richmond) trips, each way
- 8 Sacramento-Stockton daily nonstop or one-stop (Lodi) expresses, each way

- 6 San Francisco-Stockton daily nonstop or two-stop (Tracy and Oakland) trips, each way.

- 17 San Francisco-Travis daily expresses each way.

The one-way fare for the San Francisco-Sacramento trip is $4.80.

A variety of other non-express intercity service combinations are run-- 8 local San Francisco-Sacramento routes with Oakland, Richmond and Vallejo stops plus 2-4 additional stops between Fairfield and Sacramento.

Greyhound also offers commuter service both on the Peninsula and in the East Bay although some of this service was dropped when BART[1/] opened. New commute arrangements are being developed cooperatively among BART, AC Transit and Greyhound through the auspices of MTC and the PUC. In addition to scheduled service, intercity commuter service has been considered on a special operations basis service serving Sacramento government employees still living in the Bay Area. Such service could operate from specified non-terminal stops and run closed door to Sacramento if origins and destinations could be coordinated.

Non-stop trip time between San Francisco and Sacramento under "pre-energy crisis" speed limits was 1 hour and 30 minutes in the off-peak with 10 minutes additional for peak hours. Non-stop Oakland-Sacramento service was 1 hour and 25 minutes with an additional 20 minutes for a Richmond stop. The San Francisco/Oakland/Vallejo/Sacramento route took 2 hours and 5 minutes, indicating about 15-20 minutes per stop.

This scheduled service, both local and express, serves a variety of intercity trips in the region. Figure 6 summarizes the patronage pattern on a typical day and illustrates the wide seasonal variation associated with recreational travel. San Francisco, Sacramento, and Vallejo are the major generators of bus passenger trips with approximately 1700, 1030, and 860, respectively, per day in both directions combined.

Buses are most heavily patronized on weekends (including Friday) and in the summer months when a one-third increase is experienced. These are largely social and recreational trips. On an August mid-weekday, 24 percent

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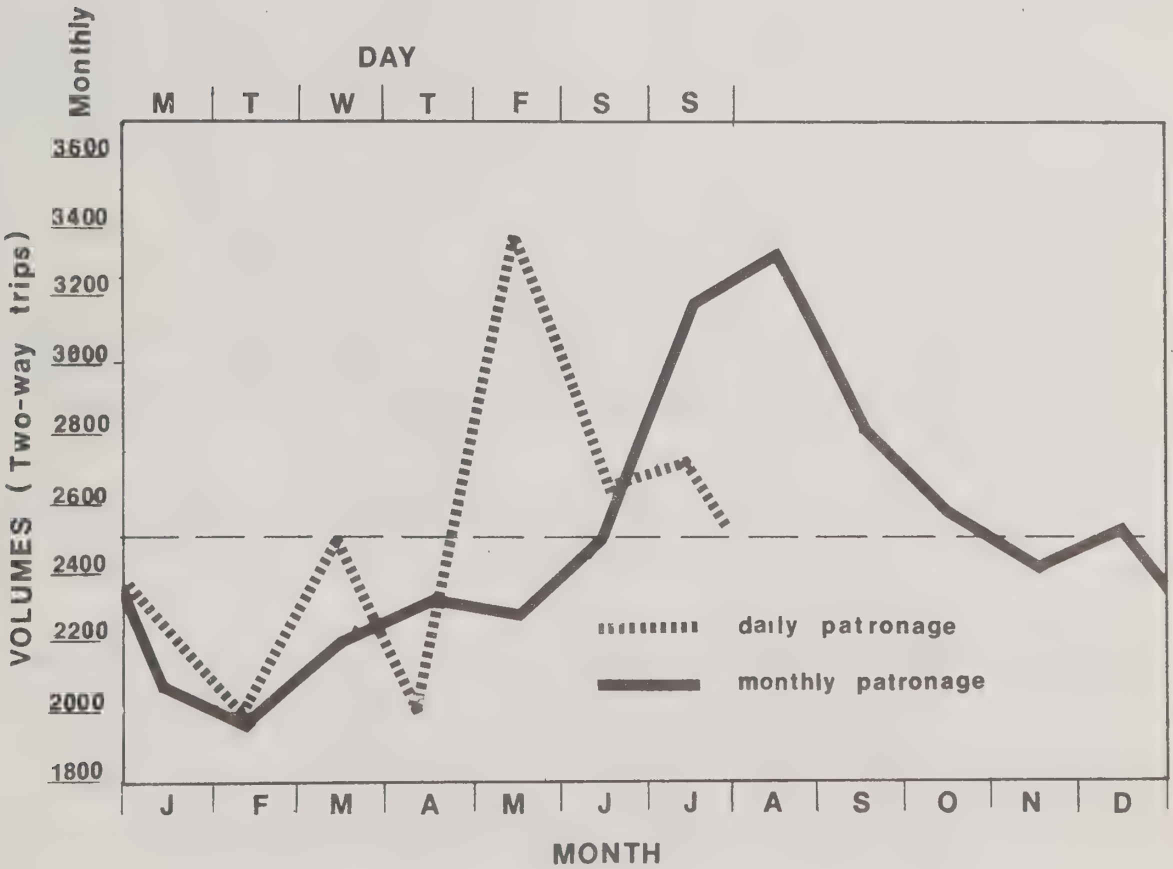
[1/] Greyhound may continue to play a commuter role parallel to BART even after BART is in trans-Bay operation since BART's initial capacity will be less than current commute bus travel in some critical corridors. However, PUC records show that many of these rates operate at a deficit owing to the inability to keep drivers effectively utilized during off-peak periods.

FIGURE 6

TYPICAL DAILY VOLUME

From:

To:	SF	OAK	RCH	VAL	STCK	TRA	SAC	SJ	
San Francisco		30	*	441	44	8	229	*	822
Oakland	65		*	36	23	8	2	*	134
Richmond	88	51		30	*	*	10	*	179
Vallejo	223	17	*		*	*	90	*	330
Stockton	66	12	*	*		49	42	44	213
Tracy	47	28	*	*	10		12	36	133
Sacramento	376	70	*	21	41	28		24	560
San Jose	*	*	*	*	42	34	12		88
	865	208		528	160	127	467	104	2,459



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SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

STUDY AREA BUS VOLUMES 1973

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of the bus trips were social-related, 23 percent personal business, 16 percent work, 14 percent recreation and 11 percent shopping. Recreation travel also provides the basis for a substantial charter service to the Reno and Tahoe area. The charter patronage is 8-10 times the scheduled patronage to those areas in the summer months.

Potential As An Improvement Program

An intercity express bus system has several important strengths as a potential improvement program. Most of these advantages relate to the technology itself:

- Guideways (existing freeways) exist and do not have to be constructed (some needed freeway operational improvements are discussed below).

- Flexibility in routing permits many routes with a varied stop mix to be extablished--providing superior service to a broader geographic dispersion of trip origins and destinations. On- or off-line operations are possible including running some routes into the downtown or using park/ride stops along freeways.

- The ability to add a bus to a route or schedule permits load-factor tailoring to demand.

- Establishment of improved intermodal interfacing (intercity feeder connections) is relatively easy through shifting the stop locations. This point of view has not yet been fully realized in practice.

- Possibility of "testing the market" wthout heavy capital investment through a trial service period. Equipment can be added in small increments.

- Relatively low operating costs (approximately 2¢ per available seat mile) reflected in low fares. Along with frequency of service, low fares are a major factor in the mode choice of existing bus patrons.

- Bus technology and equipment exist and are "off the shelf".

Examination of Greyhound operations and an on-board passenger survey carried out by this study have indicated that the speed, frequency and fares of existing bus service constitute their most attractive features. Major areas

for service improvement therefore lie in maintaining speeds, improving frequency and coverage, modal interfacing, schedules and fares, terminal environment and image improvements, and more aggressive marketing. Figure 7 compares existing intercity bus service with the approach developed for this improvement program.

Express Bus--Bay Area/Sacramento Service (Bus E)

The express bus service under development in this phase of the study are attempts to capitalize on the inherent advantages of bus technology, particularly the flexibility of routing and the ability to develop service between any two city pairs as desired. As shown in Figure 8, in contrast to the other intercity line-haul alternatives, the bus alternative has several route/stop combinations which together constitute the service. Rather than add intermediate stops to Bay Area to Sacramento or Stockton service along one line, custom-tailored service between selected pairs and combinations have been developed which respond to both the existing rider study data and Phase I forecasts. These routes include:

- San Francisco (Trans Bay Terminal) to Sacramento Express via I-80. While the future of Greyhound terminal in San Francisco is uncertain, the key principle is bringing local and intercity service together including Greyhound's Peninsula lines. The Sacramento Terminal is assumed to be a new bus terminal at 3rd and J Streets. The buses would also serve a park-ride lot at the I-80/Watt Avenue intersection to the east and could make a downtown stop on the way. This service is preliminarily scheduled for 20-minute intervals during the 5 peak hours, half-hourly on the 12 off-peak service hours. No service is contemplated between midnight and 6 a.m.

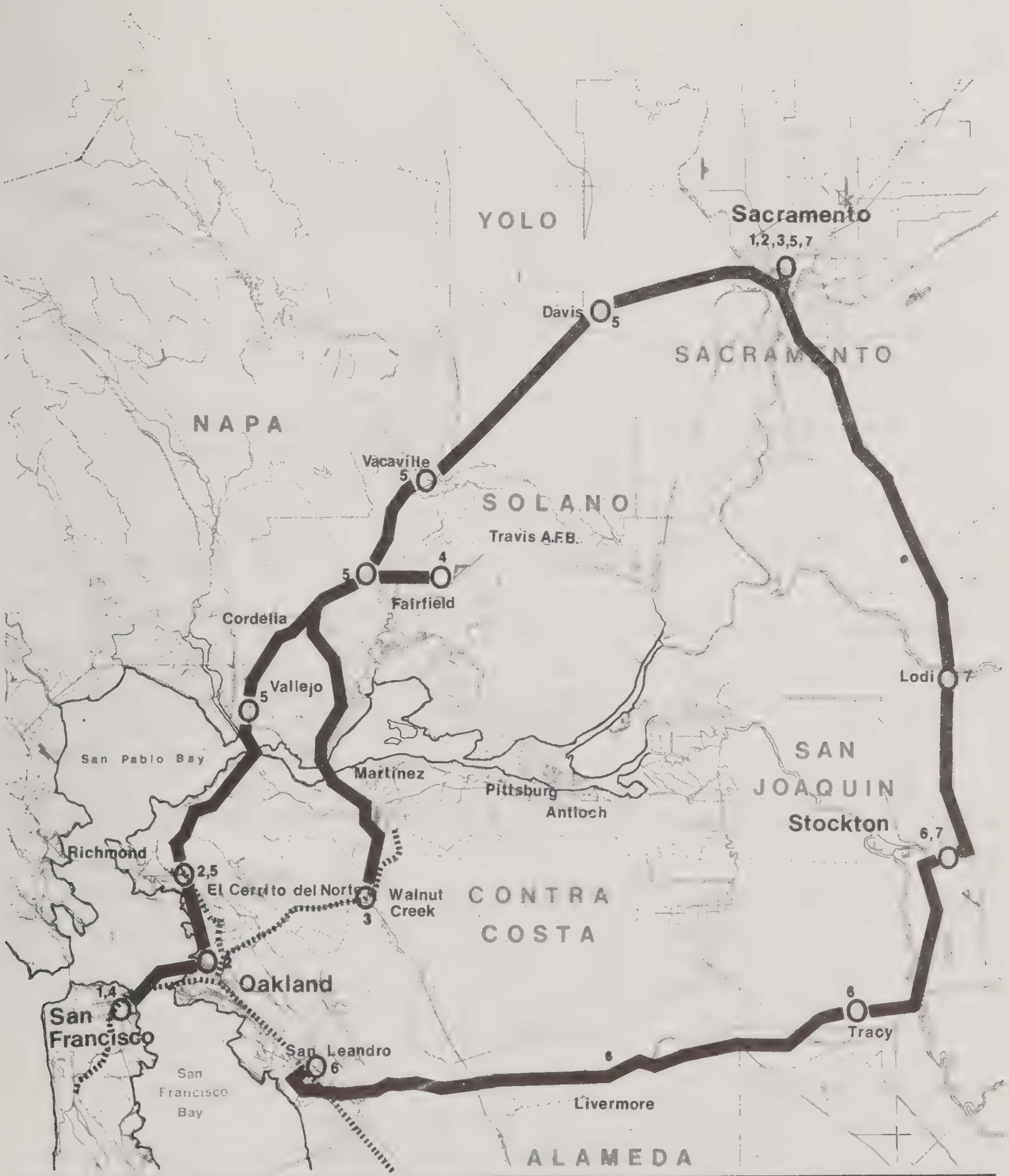
- Oakland (Greyhound Station)/El Cerrito del Norte/Sacramento via I-80. The El Cerrito del Norte station would be a bus station adjacent to the El Cerrito del Norte BART station with cross-platform transfer and AC transit feeder, including the proposed dial-a-bus system in Richmond. The Sacramento station would be the same as in the express case. Service would be half-hourly peak and hourly off-peak.

- Walnut Creek (BART Station)/Sacramento Express via highways 680, 21 and 80. This route would serve Contra Costa County. The Walnut Creek terminal would be a new terminal adjacent to the BART station with bus storage and supervision area. Service would be hourly peak and off-peak.

FIGURE 7

EXPRESS BUS STRATEGY

Typical Intercity Bus Operations	Improvement Program
• Express service between few city pairs	• Express service between several city pairs
• Terminals in few CBDs of older, larger cities	• Terminals dispersed giving better coverage
• No special feeder areas	• Close physical interface with local transit
• Intermediate stations in downtown off-highway	• Bus park-ride lots immediately adjacent to highway
• No special service by local transit	• Dial-a-bus service where good local transit coverage is absent
• Little or no parking facilities	• Adequate park-ride facilities
• Unattractive, insecure terminals	• Clear, secure terminals
• No fare/schedule coordination	• Transfer with local transit
• Peak hour congestion delay	• Possible priority treatment



KEY:

	GRADE		OPEN CUT
	AERIAL	O	STATION
	TUNNEL		BART

BUS IMPROVEMENTS

1 San Francisco/ Sacramento Express
2 Oakland/ El Cerrito del Norte/ Sacramento
3 Walnut Creek/ Sacramento Express
4 San Francisco/ El Cerrito/ Travis
5 El Cerrito d.N./ Vallejo/ Ffield/ Vacaville/ Davis/ Sacramento
6 San Leandro/ Livermore/ Tracy/ Stockton
7 Stockton/ Lodi/ Sacramento

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TRANSIT IMPROVEMENT ALTERNATIVES

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Figure 8

- El Cerrito del Norte/Vallejo/Fairfield/Vacaville/Davis/ Sacramento via I-80. Bus pads would be established at the I-80/680 interchange at Vallejo, the I-80/ Air Base Parkway ramps at Fairfield, I-80/Elmira Roads at Vacaville, I-80 at Richards Boulevard at Davis from I-80 in West Sacramento. The bus would proceed by existing ramps to city streets to the proposed Sacramento Bus terminal at 3rd and J, and finally via 99 and 80 to a park-ride lot stop and waiting station at I-80 and Watt Avenue. This service would be half-hourly during the 5 peak hours and hourly in the 12 off-peak hours.

- San Francisco/El Cerrito del Norte/Travis Air Field via I-80 and Route 12. This service would provide special service to Travis Field, which is designated by the Regional Air Systems Study as the fourth major jetport serving the Bay Area by 1985. Service would be every 20 minutes. The proposed upgrading of State Highway 12 would assist in improving this route's service.

Express Bus--Bay Area/Stockton and Stockton/Sacramento Service (Buses)

These alternatives shown in Figure 8 run from the San Leandro BART station to Stockton and from Stockton to Sacramento. The Bay Area/Stockton route starts at the San Leandro BART station, runs north on San Leandro Street, and then west on Davis Street to State Highway 17. It then turns south on Highway 17. It then turns east on Highway 238, and continues east on Interstate 580. At Livermore, a bus pad would be provided near the intersection of Livermore Boulevard and Interstate 580.

The route continues east on Interstate 580 and Interstate 205 to Tracy Boulevard. A bus pad would be located north of Tracy near the intersection of Tracy Road and Interstate 205. At both Livermore and Tracy, demand-responsive dial-a-bus feeder distribution would be established. The route then continues east on Interstate 205, north on Interstate 5 and east on Route 4. The Stockton bus station could be at the existing Greyhound terminal on Center, reached via ramps from the completed section of the Route 4 crosstown freeway.

The Stockton/Sacramento route would leave the Center Station, cross Stockton on Route 4 (when completed to Interstate 99) or return to I-5 again and continue north to a possible North Stockton park-ride terminal. From there it would cross North Stockton on Hammer Lane to Interstate 99 north to Sacramento. The last intermediate stop would be located in Lodi at the intersection of Victor Road (Highway 12) and Highway 99. At Sacramento, the route turns west on Interstate 80, then north on Interstate 99 to a proposed

bus terminal at 3rd and J Streets. A park-ride stop at the intersection at I-80 and Watt Avenue is under consideration.

Service would be hourly peak and off-peak.

Speed and Frequency

The most important factor in improved bus service is the assured maintenance of the level of service on the highways--particularly during the peak period at the urban ends of each route--I-80 below Richmond, I-80 above Davis, and on 580 in the Dublin Canyon area. Improvements over existing schedules depend on measures to maintain close-to-speed-limit conditions on I-80. In these two highway sections where congestion buildup is expected to increase, delays beyond the 10 minutes currently experienced may be expected.

While the current level of service is satisfactory, as congestion increases, priority treatment may be considered. Rather than extending the exclusive lane approach currently used on the bridge, a lane control strategy can be employed whereby a reserved lane for intercity and urban buses, taxis, emergency vehicles and possibly multiple-occupancy vehicles is established. This could be a contra-flow lane in the direction of the predominant flow. Depending on the volume of traffic which this serves, the reserved lane would be opened to multiple-occupancy private automobiles as well, depending on demand and the need to coordinate with Bay Bridge Policy as well as the desire not to compete with BART from Richmond. An alternative approach would be to abandon direct express bus service to downtown San Francisco and require a transfer to BART at Richmond.

A similar program has been conceived for the congested sections of the Yolo Causeway into Sacramento in the morning peak or on Highway 580 west of Richmond should congestion require such action. With the exception of terminals (San Francisco, West Sacramento, Oakland, El Cerrito del Norte, Walnut Creek and San Leandro) bus stops would be park-ride lots adjacent to expressway ramps with shelter facilities and local feeder bus stops--similar to the bus pad approach currently used by Golden Gate Transit buses. Sixty-second dwell times are assumed at such stops, adding 3 minutes per stop to the schedule. At terminals adequate parking facilities must be provided. Over half of Greyhound's current patronage gets to the bus by car, either as a driver or passenger, and this pattern can be expected to continue.

An additional step to maintain level-of-service is to obtain increased bus power for speed on grades via introduction of gas turbine equipment capable of maintaining 60 mph on the steep grades at Pinole and Dublin Canyon. Combined with the bus pad approach, this will permit an average speed of 58 mph between El Cerrito and Sacramento, including three stops, cutting about one-half hour off current schedules and raising the average speed by almost 18 mph.

The competitive position of express buses vis a vis the automobile for a given trip is not affected by the current 55 mph speed restriction due to fuel shortages. However, the speed restriction limits the productivity of equipment and increases the labor cost component of operating costs and will penalize bus travel in comparison to rail modes. All travel times discussed in this section assume a reversion to pre-1974 highway speeds.

Greyhound currently offers hourly express service from San Francisco to Sacramento, and 3 buses during each peak period with one stop from Oakland to Sacramento. Initial patronage figures from Phase I indicate that these frequencies could be tripled during the peak periods while maintaining acceptable load factors.

Figure 9, indicates the routes, frequencies and travel times associated with each component of the bus alternative. The headways shown are derived from the Phase I patronage estimates and are subject to revision following patronage forecasts. The daily patronage estimates were factored to hourly estimates based on the current time distribution of travel volume in the I-80 corridor.

Intermodal Coordination

The potential coverage of the intercity service is dependent on good local feeder/distribution service. Where this exists, close ties must be established. Where it does not exist, substantial ridership increases cannot be expected unless it is established.

The coverage of existing express bus service would be expanded in two ways. First, BART station stops (El Cerrito del Norte) would be added to the express and the semi-local service. In addition, new service originating from BART stations (such as El Cerrito del Norte and Walnut Creek) utilizing both BART and AC as potential feeder services, would be instituted. The frequency of these services--based on preliminary patronage estimates--would be hourly.

FIGURE 9

BUS IMPROVEMENTS ROUTE SPECIFICATIONS

	Peak Headway (Min)	Off-peak Headway (Min)	Distance (Miles)	Travel Time	Buses required (excluding 10% spares)[1/]
San Francisco-Sacramento	20	30	88	90	12
Oakland-El Cerrito del Norte-Sacramento	30	60	85	82	8
Walnut Creek-Sacramento	60	60	69	72	4
El Cerrito del Norte-Vallejo-Fairfield-Vacaville-Davis-Sacramento	30	60	76	90	8
San Leandro-Livermore-Tracy-Stockton	60	60	63	72	4
Stockton-Lodi-Sacramento	60	60	50	52	4
San Francisco-El Cerrito del Norte-Travis	15	30	50	75	13

[1/] Fleet calculations based on 20-minute layover.

Close physical coordination must be achieved with local transit facilities. In the Bay Area, cross-platform bus terminals are planned for the El Cerrito del Norte, Walnut Creek and San Leandro BART stations. The convenient relationships of these stations to limited access highways would permit parking adjacent to the BART terminal for easy transfer and would then proceed directly to the adjacent limited access freeway.

At Walnut Creek and El Cerrito del Norte, where new terminals are suggested, supervisory, storage and holding space must be established. This will require an architectural addition to the station in the long run, as well as some revision of current station parking and circulation patterns. However, temporary arrangements to institute service can be made.

In Sacramento and Stockton, terminal locations have been chosen which are well located in terms of the existing and projected local bus systems. In Sacramento, a new bus terminal is planned in the vicinity of 3rd and J as part of a new Union Bus Terminal to serve both SRTD and intercity buses. A Capital area stop and a Watt Avenue park-ride stop are also under consideration. In Stockton, the bus depot at El Dorado and Center will be well located when Highway 4 is completed crosstowm. It is also 3 blocks from the present center of convergence of local bus lines. Each of the terminals must have adequate bus storage, and layover and supervision space.

Intermediate stops which involve detouring to the present downtown bus depot locations have been abandonded since the travel time over slow speed local streets do to local stations dilutes terminal to terminal travel time without achieving improved coverage or better local modal interchange. The express bus improvement program strategy, therefore, substitutes a bus pad adjacent to the expressway with park-ride space and served by a demand-responsive dial-a-bus type feeder/distribution system.

A dial-a-bus system is an essential component of a "speed-with-coverage" approach. It would provide an on-demand service to the bus pads from the moderate and higher density areas of the cities. Potential users would call in their desire to connect with a given intercity bus and the dial-a-ride bus dispatch system would work out the most efficient way to pick up and deliver all those intercity travelers, meeting the intercity bus schedule. The systems would, in each city, employ minibuses and charge a zone-based fare depending on distance traveled. Local dial-a-ride buses would meet all arriving intercity buses.

Today such systems are handling from 50-400 demands per square mile per day in several applications around the U.S. at densities as low as 3,000 people per square mile. Each vehicle, usually 10-20 passenger minibuses can handle 10-20 requests per hour given a one-hour cycle time. Productivity is likely to be higher in the many-to-one application relevant to bus pad or intermediate station service since all passengers will either be boarding at or leaving a common place at a common time. Dial-a-bus service is particularly cost effective in the range of 20-60 demands per square mile per hour. Since waiting time is in the home and is not unusable (unlike standing on a street corner), and since the arrival time at the line-haul service is scheduled, this level of service has proven to be attractive in several applications.

The Phase I patronage estimates for Fairfield/Vallejo suggest that one or two buses would be sufficient to handle the passenger levels involved. Richmond and Davis are already planning such service. If such a many-to-one shuttle were operated solely as feeder/distribution service, the total cost of the shuttle dispatching system would be borne by the line-haul riders. If it were part of a larger city-wide demand-responsive system serving other travel purposes in a city as well, such costs should be reduced. For the higher performance systems, more buses would be necessary--up to 4 or 5. A typical 5-bus system costs $12-$15 per vehicle-hour. Operated 17 hours per day, handling 500 demands over a 50-square-mile area with an average trip length of 4 miles might cost $1.50 to $2.00 per trip, if no subsidy is assumed.

Substantial park-ride space must also be established at each bus stop. Over 50 percent of existing express bus riders access the buses by automobile either as a park-ride or by "kiss-ride" (drop-off). This indicates the tremendous importance of establishing adequate parking lots convenient to both the bus stop and local streets and highways. For the intermediate stations, bus pads, convenient as stops at highway/arterial intersections, are also generally well located for auto access. At BART-related terminals in the Bay Area, BART stations have been chosen which have the best highway access.

In Sacramento and Stockton, where new facilities may be created, special access ramps to bus terminals may be desirable. In Sacramento, I-5 ramps provide relatively good access depending on the precise site chosen for the new terminal. In Stockton, access can be created in conjunction with the completion of the Route 4 crosstown highway.

In addition to this close physical coordination, joint fares and coordinated schedules must be brought into existence if maximum bus patronage is to be generated. Currently such arrangements are under consideration among

the local transit systems (BART, AC and Muni) serving the Bay Area. This consideration of a "transit federation" approach can be extended to intercity transit as well. Implementation of joint fares between intercity and local transit could be made via a transfer arrangement reducing the fare on either component of the trip. Special transit credit cards, good on all transit, local and intercity, with monthly billings, might also be considered.

The competitive position of this mode, as well as other improvements would be improved by the use of group fares and off-peak fares. This is particularly important given the fact that often the unit making a typical intercity trip consists of more than one person. Without a group fare price reduction program with special fares for families or children, these larger groups will find it cheaper to go by automobile.

Coordinated scheduling is another important aspect of intermodal interface, since it can reduce waiting and transfer times which potential transit users find annoying. In the Bay Area, BART frequencies at the cross-platform transfer station assure an average waiting time of 5 minutes. At intermediate stations, the demand-responsive local feeder transit will minimize waiting time to 10 minutes or less. Both of these assumptions constitute a dramatic improvement over the existing situation.

Image/Marketing

Environmental and marketing image improvements are psychological factors critical to generating increased intercity bus patronage. This aspect of bus service has three components:

Bus Equipment--The "poor man's transit" image of this travel can be overcome through the provision of premium service. Aspects of premium service equipment include both greater leg and shoulder room, headrests (38" seats which recline), individual reading lights and climate control, carpeting of interior floors and sides and the separation and enforcement of smoking and non-smoking sections. Public support of intercity express bus service might suggest review of the service advantages associated with the 102-inch bus. Automatic transmissions will aid in greater smoothness of rider and lower noise levels are being achieved through suppression techniques and introduction of turbines.

Bus Stations--Bus service will not improve, nor will its market substantially increase, until private operators improve the terminal environment. Present bus stations are dirty, unattractive and uncomfortable. Prostitutes, pimps, drunks and thieves converge on the stations and together create an area for petty crime which is both unsafe and depressing. In Sacramento, for example, the Greyhound Bus terminal vicinity accounts for a third of the

city's arrests for pimps, one quarter of the arrests for prostitution and one tenth of the arrests for drunkeness and a large number for theft. Choice riders will continue to avoid the bus as long as this situation and image persists.

This problem cannot be solved by the private operator alone since the station simply constitutes an available day-and-night hangout or fertile territory for elements of a local urban society for which social and law enforcement agencies must be partially responsible. In addition, new terminal plans and terminal relocations often become ensnared in local politics and urban renewal schemes over which the private operator has little control.

Bus Marketing--Intercity bus marketing is still in its infancy reflecting the carrier's reliance on captive rider-ship with no alternative. This attitude, which is also evidenced by the total absence of amenity in current operations, constitutes a fundamental psychological barrier to improved service which must be overcome by the carrier if intercity express bus service is to live up to the patronage potential provided by its flexibility, speed and economy.

Marketing must focus on two objectives:

- Increasing patronage -- by focusing on customer needs and how a service can be developed to meet them (image) and then making potential users aware of the service.

- Gaining public support for the system

A marketing program must therefore both improve the image through its attitude, responsiveness, and reliability, and then deliver the service. Potential riders must be aware of transfer and park-ride opportunities, routes and frequencies, the cost of the ride compared to alternatives and other amenities.

Capital Costs

Construction required for these alternatives would include new terminal facilities at El Cerrito del Norte, Walnut Creek and San Leandro. At El Cerrito del Norte, Cutting Boulevard would be used to access the station. Walnut Creek access to Highway 580 would be via Main Street and Ignacio Valley Road. At San Leandro, Davis Street would be used as access.

Bus pad construction is required at the intersections of I-80 with the following roads:

- 680 (Vallejo)
- Air Base Parkway (Fairfield)
- Elmira Road (Vacaville)
- Richards Boulevard (Davis)--possible joint park-ride lot with SRTD.
- North Stockton
- Tracy
- Lodi

A new Sacramento bus terminal in the vicinty of 3rd and J Streets is currently under discussion in Sacramento and is not included in the costs.

The major costs associated with the bus alternatives are costs of new vehicles and costs of terminal, bus pad and traffic operations improvements. For comparability the costs of the required buses have been calculated at 58 buses costing $4-5 million. The capital costs of bus pads and terminals is estimated at $4 million. Traffic operations improvements have not been assumed as an assignable cost to this system.

Initiation of New Service

Several institutional potentials are associated with a bus-based alternative. There is an established experienced private operator prepared to offer service if a reasonable rate-of-return is available. However, it is not likely that a private operator can be expected to take special risks or accept reduced returns in the "public interest". If there is a public decision that a greater frequency of service between the two points is in the public interest and a market has not been "discovered" by the private operator, there must be a mechanism to bridge this gap between the private market and the public policy. One option is to let the bus fare rise in keeping with the lower ridership; however, this may be self-defeating. Another is to increase the frequency and subsidize the fare under the assumption that this differential is providing some greater public benefit. This implies the need for a new arrangement between institutions representing public service and the private operator with a possible sharing of the risks of new service.

Control over routes, fares, and schedules is now exercised by the State Public Utilities Commission following its jurisdiction under the State Constitution. The PUC regulates all non-urban vehicles affected with the "public interest", including common carriers. Private bus operators, such as Greyhound,

operating schedules service between fixed terminals over a regular route outside local jurisdiction, come under its regulation.

Through both formal hearings and informal administrative activities, the PUC attempts to respond to a request for a change, increase, or decrease in service and fares. An application or complaint can be brought to the PUC through a petition process--such as a request for a new service by a potential user group or an application for a rate increase by an operator. These are either resolved administratively by the PUC through a resolution or an ex parte decision without a hearing or handled through a formal hearing procedure.

In cases of petitions for new service, a test period is generally agreed upon by the utility (bus operator) and the commission staff with ground rules as to what constitutes conditions justifying continued service based on a judgment balancing the public interest of the petitioner against the general economic health of the operator.

The assumption has been made to date that the improvements under investigation can be made through institutional arrangements among the existing private operators, the PUC and a new intercity public transportation institution. This new institution, whose shape is discussed in Section IV, might serve to define needed service improvements, assist in the testing and development of such routes, and be eligible for federal and state funds.

EXISTING RAIL ALTERNATIVE

Passenger rail transportation was once the chief intercity mode in the study region. As recently as 1950, Southern Pacific offered 11 trains per day between Sacramento and Oakland on a 1 hour 35 minute schedule for one-stop service. Southern Pacific tracks were designed to handle speeds over 100 mph in the straight stretches and crack passenger trains had priority over freights. The Sacramento Northern Railroad also offered regular service from 1907 to 1940. At its peak, it made the Sacramento to Oakland run in two and one-half hours despite two ferry crossings. Other lines offered Sacramento to Stockton service. The Southern Pacific railroad built a bridge across the Carquinez Straits in 1930 and became the dominant passenger carrier. Growing use of the automobile and bus, plus the depression, killed intercity rail by 1960.

Present Service

Today one Amtrak passenger train runs each way between Oakland and Sacramento to and from Chicago; another train runs between Oakland and Davis, part of a Los Angeles to Seattle route. The trains maintain a one hour and

40 minute schedule from Oakland to Sacramento at an average speed of 47 mph. The speed is limited by technical factors such as alignment curvature and track conditions, limiting maximum speed to 70 mph, local city speed limits, reliance on single directional automatic block signals, and on-balance superelevation of curves designed to minimize track wear for relatively slow speed freight trains. Simply stated, Southern Pacific tracks between Oakland and Sacramento have been designed for freight traffic.

Operational problems also limit the level of service. The intermixing of the passenger train with freight movements places limits on speed in the absence of automatic train controls and passenger train priorities. In some locations, for example, the mainline is used for freight switching movements.

The Santa Fe track offers a similar picture between Oakland and Stockton. Passenger service from Oakland to Bakersfield via Southern Pacific and Santa Fe track--one train per day in each direction--was initiated in March 1974. In addition to being designed for freight, most of the route is single track between Oakland and Stockton. Between Stockton and Sacramento, the most direct route (via Lodi) is offered by the Southern Pacific, a mix of single and double track--also oriented to freight traffic.

Potential As An Improvement Program

The major advantages of reestablishing rail passenger service are threefold. First, the technology is available. Conventional self-propelled diesel electric equipment with power sufficient for 90 mph is are currently run over all the major rail connections in the region. Second, the basic guideway exists, although it is not in condition for 90 mph operations. There is continuous double track between Oakland and Sacramento and intermittent single and double track between Antioch, Stockton and Sacramento. With the exception of the area within Alameda and Contra Costa Counties, the rail alignments are relatively straight and level and amenable to increased train speeds if track quality is improved. Third, there is an existing rail passenger operator, the National Railroad Passenger Corp. (Amtrak), which currently operates the passenger trains. Amtrack owns the equipment and has its own staff but contracts for train operating personnel from the private railroads.

The major impediment to improved rail passenger service are problems associa associated with integrating increased public passenger trains with private freight operations. Southern Pacific and Santa Fe serve important industries--sugar and oil refineries and steel plants--along the Bay and the Carquinez Straits. In addition, the Southern Pacific railroad serves sugar beets, canning and other perishable produce industries via spurs off the mainline between

Fairfield and Sacramento. Local freight movement, as well as shipments between Oakland and Chicago and along the Pacific Coast, represent an important economic function in this region. The interference of added passenger service to the efficiency of the freight transportation system of the region is an issue which must be addressed.

The amount of through and local freight traffic, as well as its diurnal and seasonal variation, is critical to determining the degree of difficulty that would be experienced in integrated passenger/freight operations. No detailed information is available about Southern Pacific operations at the present time because of the railroad's decision to provide only limited cooperation with this study. Southern Pacific (SP) has made track charts, special instructions, and right-of-way plans available, which have been supplemented with visual inspection, U.S. Coast and Geodetic Survey maps. However, operations data, such as dispatchers records, train manifests and switching records necessary for feasibility analysis, have not been supplied. All operation inferences discussed below are based on visual counts and reference similar contexts in other parts of the country.

Southern Pacific Railroad traffic varies from season to season. It is heaviest in the fall harvest period of September and October. While the eastbound versus westbound traffic varies from day to day, schedules are arranged around weekday loadings and unloadings. During the peak months, it is estimated that the Southern Pacific operates between 10 and 15 freights per day in the predominant direction and up to 10 in the reverse direction. This predominant direction varies by day of the week. In addition, there is some local switching activity. The traffic is heaviest between Davis and Oakland since trains to the northwest cut off at Davis. Two Amtrak passenger trains are run daily in each direction. In addition, there are from 2-5 trains per day, each way to and from Napa junction during the heavy season, which enter or leave the mainline at Fairfield.

The freight trains vary from 50-100 cars which is equivalent to between 3,000-6,000 gross tons. These freight movements are generally spaced throughout the day, with more than an hour between trains-- except eastbound departures in the afternoon, which are often scheduled more closely.

Santa Fe traffic between Oakland and Stockton is less--5-10 through freights plus one or two local freights. During the peak season in August and September, one or two additional freights may be operated. Train length appears shorter than Southern Pacific--about 30-50 on the average. In addition to through and local freights, there is considerable switching activity in the Pittsburgh/Antioch area.

Underlying the design of the Existing Rail Improvement Programs is the objective of capitalizing on its obvious advantages. It requires a relatively small capital investment, building on existing technology, existing guideways, and existing institutions. It can be implemented on a gradual basis with selective improvements and limited service with no danger that investments in cars or track would be lost.

Four types of improvements are required as preconditions to the institution of effective passenger rail service in the region. First, it is necessary to upgrade the existing roadbed and track to permit 90 mph operation where not limited by curves or bridges. To bring the track work up from the existing 70 mph speed limit, 59 miles of Southern Pacific track east of the Carquinez Straits must be upgraded to FRA Track Standard Class 5 from its present Class 4 condition. The track south of the Carquinez Bridge curving along San Pablo Bay with numerous speed restrictions, would be left largely as is.

Second, a train control system consistent with the total traffic level must be implemented. Automatic train stop or cab signals will probably be required. Depending on the frequency of service, centralized train control and passing track may also be necessary.

Third, sufficient cars, including spares, must be obtained for the schedule under consideration. At the present time, there is a substantial demand for existing rail equipment.

Both Amtrak and privately owned passenger equipment in running condition are being increasingly utilized in response to the "energy crisis". Assumptions used in comparative capital costs assume the purchase of new vehicles, such as the turbo-train equipment Amtrak has recently purchased.

Fourth, a substantial improvement in the local feeder and distribution system is necessary. The advantages of investments in the increased line-haul speeds of fixed guideway systems can only be capitalized on if it is possible to access the terminals and stations easily and cheaply from a wide range of potential local origins and destinations. Total door-to-door travel time, not simply line-haul travel time, is the criterion of merit which gives the automobile its inherent advantage.

Three separate improvement programs have been developed as opportunities for the employment of conventional rail equipment. Each program capitalizes on existing track. The Oakland/Sacramento route (Rail RE) has stops at Richmond, Martinez, Fairfield and Davis. Consistent with the moderate

investment approach, existing stations would be used. The Bay Area terminal would be the current Amtrak station at 16th and Wood Street in Oakland. The Sacramento terminal would be the existing Southern Pacific Depot at 4th and H Streets. Intermediate stops would require refurbishing of the existing Southern Pacific stations.

The West Pittsburg-Sacramento Route (Rail PE) has been designed to test an eastern Contra Costa County connection to Sacramento. It assumes the extension of BART to West Pittsburg as per BART's current Pittsburg/Antioch Extension Study. In contrast to Alternative RE, new track would be required between West Pittsburg and Cannon, built largely on the Sacramento Northern right-of-way which is little used. It would have a stop at Travis (Fairfield) serving the proposed fourth major jetport in the Bay Area--and a stop at Davis.

Conventional rail service crossing the Carquinez Straits assumes that bridge opening schedules can be developed that will give passenger service priority over river traffic during the peak periods, as in other cities.

The Antioch-Stockton route also requires new track where the existing Santa Fe is single-tracked. It would have no stops between the proposed BART extension to Antioch and Stockton although a future possibility exists at Knightson (serving the Brentwood area). Alternative AE also would run from Stockton to Sacramento via Lodi on the existing Southern Pacific right-of-way which also requires new track where the Southern Pacific is single tracked. In Sacramento, the existing railroad depot would be utilized. In Stockton, existing depots may be used, or a new alternative under the new crosstown freeway may be considered.

The comparative performance of the conventional rail alternative is shown in Figure 10. The travel times shown can be compared with Oakland/Sacramento express bus service (with one stop) of 1 hour 55-minutes or the current Amtrak nonstop hour and 40-minute service. Headways shown on the table are used for first-round patronage forecasting. They will be adjusted in response to patronage levels and are not a fixed component of the improvement program.

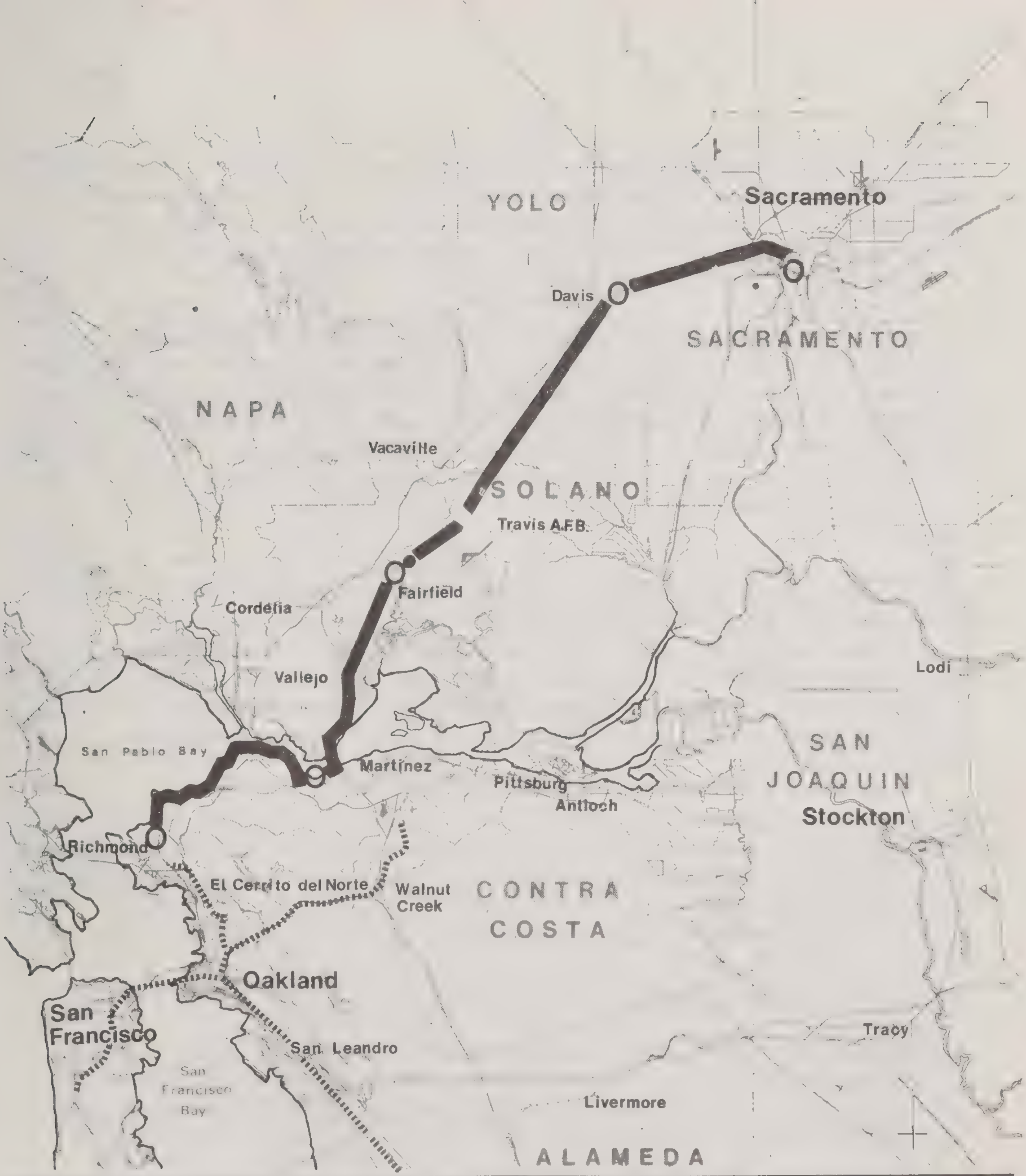
<u>Oakland/Sacramento Service (Rail RE)</u>

This alternative does not require new right-of-way as shown in Figure 11. It utilizes the existing Southern Pacific Railroad tracks between the Oakland 16th Street Station and the Sacramento Terminal via the Benceia Bridge.

FIGURE 10

CONVENTIONAL RAIL ALTERNATIVES PERFORMANCE

	Terminal Stations	Intermediate Stations	Distance (miles)	Average Speed (mph)	Travel Time (min)	Peak Hour Headway (min)	Off-Peak Hour Headway (min)
RAIL RE	16th St. Oakland	Richmond					
RAIL RE	16th St. Oakland SP Depot, Sacto	Richmond Martinez Fairfield Davis	87	61	85	20	40
RAIL PE	W. Pittsburg BART Station (Proposed) SP Depot, Sacto	Travis (Fairfield)	55	74	45	20	40
RAIL AE	Antioch BART Station (Proposed) Santa Fe Depot, Stockton	None	32	76	26	20	40
RAIL AE	SP Depot, Stockton SP Depot, Sacto	Lodi	48	69	42	20	40



KEY:

RAIL RE: RICHMOND/SACRAMENTO

GRADE
OPEN CUT
AERIAL
STATION
TUNNEL
BART

SSBACS

SACRAMENTO ▪ STOCKTON ▪ SAN FRANCISCO BAY AREA ▪ CORRIDOR STUDY

TRANSIT IMPROVEMENT ALTERNATIVES

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Figure 11

An 86-minute schedule includes intermediate stops at existing Southern Pacific Railroad stations at Matinez and Davis, and new stations at Richmond and Fairfield. These stations must be supplied with expanded park-ride capabilities and serve as the terminals of local dial-a-bus systems. The assumptions underlying the need for these demand-responsive feeder systems are outlined in the Express Bus (Bus E) discussion above.

From the 16th Street station, the track alignment winds along San Pablo Bay and Carquinez Straits in a northerly and easterly direction, respectively. The track crosses the Carquinez Straits parallel to and on the eastern side of the Benecia-Martinez Bridge. It then runs in a northeasterly alignment to Sacramento, linking the cities of Fairfield, Dixon and Davis. The Sacramento terminal would be the existing Southern Pacific Railroad Station. The total distance between Oakland and Sacramento Terminals would be 86.5 miles.

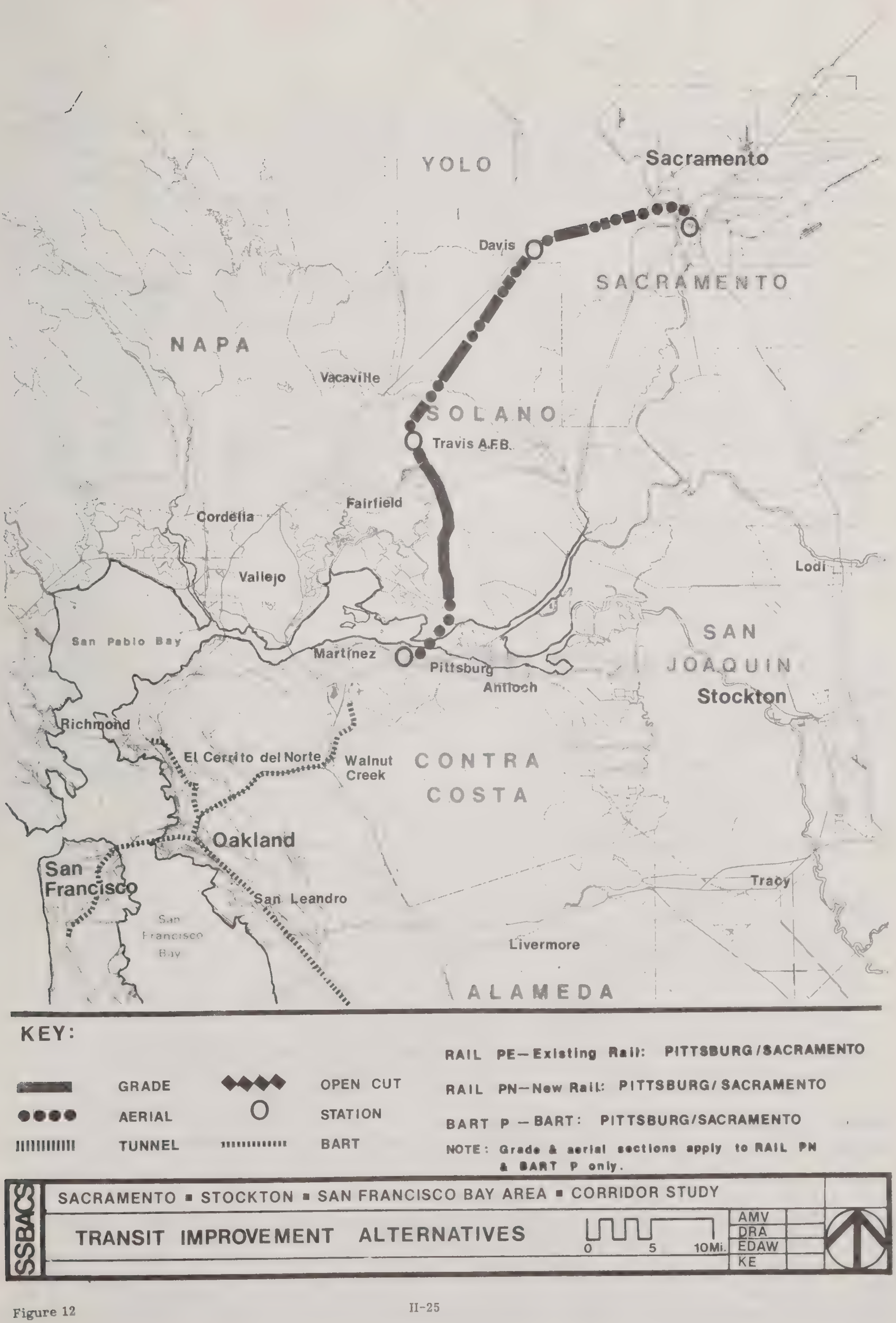
Upgrading of track from 70 mph to 90 mph would be required where straight track permits this speed. This involves bringing the track up to FRA Track Standard Class 5, for a total distance of 59 miles. Maintenance and storage facilities would be located between Davis and Sacramento or in the Southern Pacific Sacramento yards occupying an area of 17 acres. Facilities would be provided for storage, servicing, light maintenance, and overhaul.

Schedules envisaged as part of the Rail RE alternative, based on Phase I preliminary forecasts were 20-30 minutes during the peak periods and 35-60 minutes during the off-peak. Peak hour trains would be a 3 car consist. These schedules will be altered in accord with final patronage data and the need for passenger/freight service integration.

<u>West Pittsburg/Sacramento Service (Rail PE)</u>

This alignment makes use of existing Southern Pacific track above Cannon, as in the case of Rail RE. However, between West Pittsburg and Cannon new track would be required and the alternative is, in this section, similar to Rail PN or BART P. It is shown on Figure 12.

This alternative would have the same alignment and stations as Alternative BART P from West Pittsburg to the vicinity of Cannon and the Southern Pacific Railroad mainline. From Cannon to Sacramento, the existing Southern Pacific Railroad line would be utilized in the same manner as described in Alternative RAIL-RE.


YOLO
Sacramento
Davis
SACRAMENTO
NAPA
Vacaville
SOLANO
Travis A.F.B.
Fairfield
Cordelia
Vallejo
Lodi
San Pablo Bay
Martinez
Pittsburg
Antioch
SAN
JOAQUIN
Stockton
Richmond
El Cerrito del Norte
Walnut
Creek
CONTRA
COSTA
Oakland
San
Francisco
San Leandro
San
Francisco
Bay
Tracy
Livermore
ALAMEDA
KEY:
GRADE
AERIAL
TUNNEL
OPEN CUT
STATION
BART
RAIL PE—Existing Rail: PITTSBURG/SACRAMENTO
RAIL PN—New Rail: PITTSBURG/SACRAMENTO
BART P —BART: PITTSBURG/SACRAMENTO
NOTE: Grade & aerial sections apply to RAIL PN & BART P only.
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TRANSIT IMPROVEMENT ALTERNATIVES
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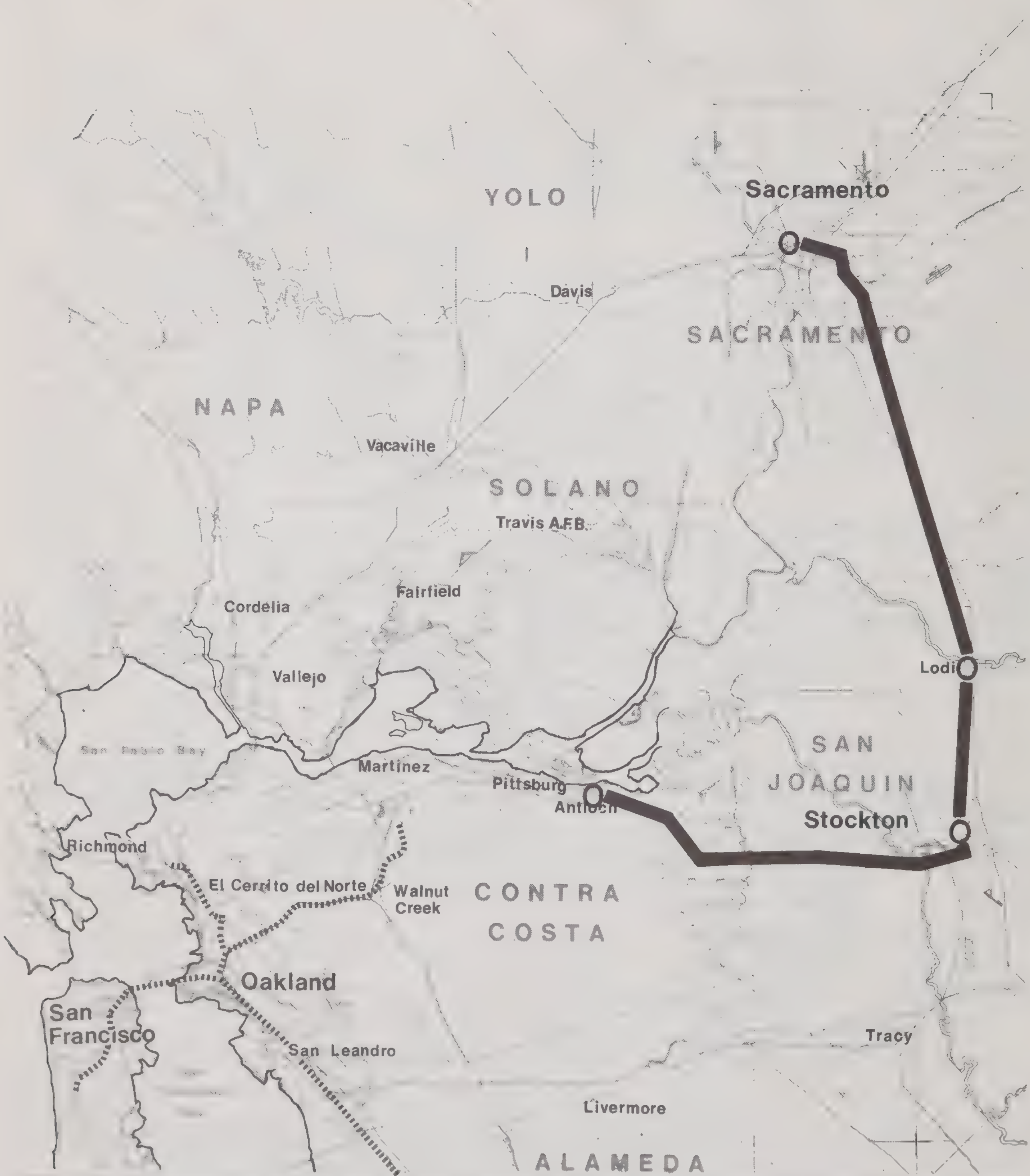
Figure 12



EY:

▬▬	GRADE	◆◆◆◆	OPEN CUT
●●●●	AERIAL	O	STATION
IIIIIIIIII	TUNNEL	ıııııııııı	BART

RAIL AE: EXISTING RAIL-
ANTIOCH/STOCKTON/SACRAMENTO

RAIL AN: NEW RAIL-ANTIOCH/STOCKTON/SACRAMENTO

SSBACS

SACRAMENTO ▪ STOCKTON ▪ SAN FRANCISCO BAY AREA ▪ CORRIDOR STUDY

TRANSIT IMPROVEMENT ALTERNATIVES

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Figure 13

Intermediate stops would include a new station at Travis Air Force Base (when a new jetport is developed) and the existing Southern Pacific Railroad Station at Davis. Upgrading of existing track from 70 mph to 90 mph standards would be required. This involves bringing the track up to FRA Track Standard Class 5, for a total distance of 32.7 miles.

Facilities would be provided for storage, servicing, light maintenance, and overhaul, occupying an area of 14 acres between Davis and Sacramento or at the Southern Pacific Sacramento yards.

Antioch/Stockton--Stockton/Sacramento Service (Rail AE)

This alternative, shown on Figure 13, would utilize the existing tracks of the Sante Fe Railway from Antioch to Stockton and the existing Southern Pacific tracks from Stockton to Sacramento.

The Antioch terminal would be located adjacent to the proposed BART Antioch Station. While no intermediate stops between Antioch and Stockton are currently planned, a Knightson stop, servicing the Brentwood area, would be possible if warranted by increased residential development.

Two terminal options are available in Stockton. If the route terminated in Stockton, the existing Santa Fe Terminal could be used. This avoids the necessity of operating over numerous grade-crossings. The station location is not ideal in terms of good arterial or expressway connections or bus service, but Dial-a-bus type feeder service would assist in overcoming this problem.

An alternative location may be either the existing Southern Pacific Station or a new location under the crosstown freeway. While provision of parking may be a problem, both of these locations are well located in respect to bus service, as they are both 3 blocks west of the current convergence of the bus lines. However, both require street level low-speed operation of the railroad because of grade-crossings and switching operations.

Upgrading of the existing track to FRA Track Standard Class 5 would be required to permit 90 mph operation, where not limited by curves and local speed restrictions in Stockton. In addition, a new parallel track would be constructed in places where the existing alignment consists of a single track.

For the Stockton to Sacramento Service, Santa Fe tracks on Taylor Street would be connected to Southern Pacific tracks on Sacramento Street by

means of a single track that would cross the city block bounded by Aurora, Sacramento, Taylor and Scotts Streets. From that point the service would follow the Southern Pacific tracks to Sacramento via Lodi. Grade separations are not planned as part of this alternative, but possible separations are identified below. As in the case of the Antioch/Stockton service, considerable new track would be required:

	Antioch-Stockton (miles)	Stockton-Sacramento (miles)
Upgrading of the existing double tracks	8.0	14.6
Upgrading of the existing single track	21.7	27.9
New single track: At grade	19.8	26.9
Trestle	2.0	1.2

The total distance between Antioch and Stockton terminals would be 32 miles and 48 miles between the Stockton and Sacramento terminals for a total of 80 miles.

Separate maintenance and storage facilities, if necessary, could be located south of Sacramento, occupying an area of 15 acres. Facilities would be provided for storage, servicing, light maintenance, and overhaul.

Intermodal Coordination

The conventional passenger rail system must be tied closely to both the local transit and streets systems. In the Bay Area, a special shuttle would be run between the Amtrak station and 16th and Wood Streets to the Oakland West BART Station. The AC buses to downtown Oakland would also be coordinated. At the Richmond BART Station, as well as the projected BART stations at West Pittsburg and Antioch, a direct pedestrian tie between BART and rail platforms via escalators or travelators would be implemented. A dial-a-bus system is currently being implemented in Richmond which will also serve the rail improvement.

In Sacramento, routing most city buses to the Southern Pacific depot would not be difficult if the currently planned bus terminal is established in that area. This location will also reinforce historic renewal and urban development plans in the area.

The intermodal interchange opportunities in Stockton include either the existing Santa Fe or Southern Pacific stations. The former avoids

the necessity of operating over track with several grade-crossings but has poor automobile access and bus connectors. The latter, however, has better ties to expressways (Route 4) and the center of bus service three blocks away. To minimize traffic disruption, limited grade-separation such as the Oak/Parker and Main/Market, Lincoln and Stanislaus, and Bianci should be considered if the line is continued to Sacramento. The City's plan currently includes grade-separation at California Street, West Lane, March Lane, Hammer Lane, Mirada Lane, and Eight-Mile Road. These have not been included in the cost estimates. Where train frequency or automobile traffic volumes indicate grade separations are not necessary, gates and signals would be installed.

Over 50 percent of the existing express bus riders access the buses by automobile either as a park-ride or by "kiss-ride" (drop-off). This indicates the tremendous importance of establishing adequate parking lots convenient to both the railroad station and local streets and highways.

In the smaller intermediate cities along rail routes that do not have good local bus systems, a new feeder-distribution bus system will be required in addition to park-ride facilities. Given the small size and low density of these areas and the relatively dispersed origins and destinations of potential intercity travelers, a fixed route local bus system would not be an efficient solution. Therefore, a demand-responsive dial-a-bus system has been assumed for those cities (Martinez, Fairfield, Davis, Pittsburg, Antioch, and Lodi). Such a system of small vehicles with a phone reservation system would provide an on-demand ride between home or other locations and the relevant intercity transit station. This type of service is discussed in the Express Bus System description above.

In addition to this close physical coordination, joint fares and coordinated schedules must be brought into existence if maximum railpatronage is to be generated. Currently, such arrangements are under consideration among the local transit systems (BART, AC and Muni--serving the Bay Area). This consideration of a "transit federation" approach can be extended to intercity transit as well.

Capital Costs

The comparative capital costs of the rail alternatives includes the costs of vehicles to achieve the frequencies and consists indicated in Figure 14, and the track upgrading and structures, yards, controls and communications necessary, grade-separations have not been included. The total cost for each alternative and the percentage breakdown is shown below:

FIGURE 14

CAPITAL COSTS -- CONVENTIONAL RAIL

	Comparative Costs (Millions)	Percent of Total Cost: Stations Structures	Operating[1/] Subsystems	Vehicles
Rail RE	$ 50	9%	17%	74%
Rail PE	$ 300	92%	5%	3%
Rail AE				
Antioch-Stockton	$ 50	67%	16%	17%
Stockton-Sacramento	$ 50	67%	16%	17%

Implementation Problems

Passenger-freight integration is the key operational issue underlying the feasibility of this alternative. The difficulty of integrating passenger and freight operations depends on precise knowledge of existing and proposed freight and passenger schedules. This difficulty will increase as the frequency of either type of service is increased. Proposed schedules must ultimately be reviewed to determine the need for new passing track, revised interlocking or signals, centralized train controls, and other communication and safety equipment. Train frequency assumptions used in this phase have been chosen for market testing purposes, and a more definite judgment on integration problems can be made following patronage forecasts.

In the absence of railroad cooperation, only qualitative statements can be made about the difficulty of passenger/freight integration. Graphic redispatch analysis or computer simulation requires railroad dispatcher and switching records and train performance calculations. Reference can be made to analagous situations around the country where similar freight operations accommodate both intercity and commuter operations at an appropriate level of service. One example of such a situation is the Southern Pacific line between San Jose and San Francisco where, on a double track line, 50 daily passenger trains are spaced with 10-15 freights. Railroads in other areas of the country, such as Chicago, also mix large numbers of passengers and freight operations. While these examples are

[1/] Fare collection, yards and shops

not definitive with respect to their applicability to the Southern Pacific situation, they suggest that the possibility of integrated service deserves serious consideration--particularly in the light of possible substantial service improvements at a moderate cost.

The position of the Southern Pacific is opposition to <u>any</u> form of joint freight/ passenger operation. The expanding role of government in railroads' operation, particularly in the east, in combination with the railroads' perception of a growing attitude on the part of the public that private rail rights-of-way are in a sense a "public utility" has put the railroads on the defensive in respect to their property rights. The railroads fear that service to their freight customers may be hampered as a byproduct of developing improved passenger transportation.

These factors have combined to generate defensiveness on the part of railroads in respect to public interaction--particularly in studies where cooperation with public agencies seems often to be interpreted as acceptance of proposals. For example, the railroads' position has been that provision of operations data to this study is irrelevant owing to their position of not considering shared use of their tracks. While this attitude has inhibited interaction and the availability of technical data, it is hoped the railroads' position may alter if clear recognition is given to their requirements for the operation and development of freight service along the major corridors.

Indeed, a substantial increase in passenger service would likely require some adjustment in freight operations and equipment as well as capital improvements to rail infrastructure. Amtrak's Basic Agreement with participating railroads establishes the principle of passenger service provision as well as mechanims to arbitrate disputs about compensation. The cost sharing of the burden of track improvements, new passenger track if necessary, wayside and on-board train controls, and communications and power pool increments required must be carefully worked out to insure equity while introducing passenger service and maintaining the quality of freight service. Recent events, both in respect to the position of Congress, court decisions and arbitration as well as the urgency of the energy crisis, may assist in altering the climate for more fruitful discussions. Section III discusses techniques for implementing new rail passenger service.

IMPROVED PASSENGER TRAIN ALTERNATIVE

Improved Passenger Train (IPT) technology is the direct descendent of the conventional rail systems in current operation. With the major portion

of the traction power absorbed by air resistance, and air resistance varying as the square of the speed, steel-on-steel sections remain an extremely efficient technology at speeds under 250 mph where comfort and guidance problems can be overcome.

Potential as an Improvement Program

Improved Passenger Train vehicles are available which can operate at considerably greater speeds than those offered by present service, with comfort over improved or new tracks. Such a system takes advantage of the latest generation of operational steel-on-steel technology, such as that exhibited on the Tokkaido Line in Japan, the Metroliner in the Northeast and current turbo-train operations in France, Canada, and the Midwest. For operation on non-electrified track, gas turbine propulsion, hydraulic transmission, improved aerodynamics and tilting body suspension have been combined in self-propelled turbine-hydraulic turbotrain vehicles.

These engineering advances involved an approximate 30 percent increase in speed on curves and better acceleration. The speed is accomplished by moderate power increases of multiple diesel engines accompanied by the weight decreases of aluminum construction. The ride quality at these speeds is aided by improved suspension; both comfort and speed, however, depend on track condition.

Both the French National Railroad (SNCF), through its American licensee, Rohr Corporation, and United Aircraft Sikorsky Division have produced turbotrains for Amtrak. The former are operating between Chicago, St. Louis, and Milwaukee, and the latter are currently in use between New York and Boston. On high quality track, these trains have reached 170 mph and can cruise economically at 120 mph. This type of operation requires a modern train control system and guideway, particularly if mixed, with low speed traffic.

Two approaches to using this vehicle technology in the study area are possible. One approach uses turbotrains on upgraded Southern Pacific or Santa Fe tracks. Track limitations, grade-crossings, and other safety problems impose a 90 mph top speed -- the same as that achieved with conventional diesel electric equipment. The superior acceleration, deceleration, and suspension characteristics of the turbotrain, give it a 10-minute travel time advantage over standard diesel electric locomotives on the 4-stop Oakland-Sacramento run. This approach is not discussed in detail, but the speed and travel time differences are shown in Figure 15.

FIGURE 15

CONVENTIONAL VERSUS IMPROVED EQUIPMENT ON EXISTING RAIL--PERFORMANCE COMPARISON

				Av. Mph Speed		Travel Time(Min)		Peak Hour	Off-Peak Hour
	Terminal Stations	Intermediate Stations	Distance	Diesel-Electric	Turbo-train	Diesel-Electric	Turbo-train	Headway (min)	Headway (min)
RAIL RE	16th St. Oakland SP Depot Sacto	Richmond Martinez Fairfield Davis	87	61	68	86	76	20	35
RAIL PE	W. Pittsburg BART Station (Proposed) SP Depot Sacto	Travis (Fairfield) Davis	55	74	83	45	40	20	40
RAIL AE	Antioch BART Station (Proposed) SP Depot Stockton	None	32	76	76	26	25	20	40
RAIL AE	Santa Fe Depot Stockton SP Depot Sacto	Lodi	48	68	69	42	42	20	40

The second approach to using turbotrains is designed to achieve 120 mph top speed. This approach, discussed in greater detail below, requires new welded rail and track structures, revised geometrics, elimination of grade crossings and improved train controls. This alternative would not, therefore, use existing track. New track would be constructed along existing track within railroad rights-of-way. Freight/passenger train conflicts would be eliminated.

The major differences between conventional vehicles on existing track versus Improved Passenger Train technology on new tracks is in the speed and comfort advantages of turbotrains. The speed implications between the two systems (diesel electric standard rail at 90 mph top speed versus turbotrain/ new rail at 120 mph top speed) is best illustrated by average speed on the Oakland to Sacramento run--61 mph versus 96 mph. This speed difference results in a 47-minute travel time (3 stops) versus an 86-minute travel time (4 stops).

This decreased travel time will result in greater productivity in terms of passenger miles per day. With a greater number of round trips made by a given vehicle per day, the fleet requirements are smaller. The service improvement and operating economy is, of course, purchased at the considerable cost of new rail structures, track ties, surfacing, super elevation, etc.

Alternative Route/Stop Combinations

The 120 mph top speed of light weight turbine hydraulic trains cannot be achieved with comfort or safety on existing rail. Construction of new track, railbed, and train control systems with right-of-way fenced and grade crossings eliminated are fundamental requirements. Three route/stop combinations have been investigated for possible Improved Passenger Train service. All three were planned with certain criteria in common:

- Deliver maximum service to the existing cities between terminals consistent with high speed service over the entire trip

- Minimize community and environmental impacts such as dislocation or ecological disturbance

- Minimize costs

These objectives led to the selection of existing transportation rights-of-way as the most favorable route locations. The existing major rail and

highway corridors are located to permit station location with either good downtown access or stations with more suburban park-ride orientation. At the same time, the land uses around the existing transportation rights-of-way have adjusted to them so that noise or visual disturbance is likely to be less than in the case of a new right-of-way. Similarly, the environmental impact associated with rights-of-way has already been felt such that additional construction and operations would have a minimal effect.

The proposed routes have been developed for comparative purposes--each using existing rights-of-way as route locations for new construction.

- The first route, RN, would follow Southern Pacific operating railroad right-of-way between Richmond and Sacramento via the laying of new track along existing tracks largely within Southern Pacific right-of-way which is 100 feet wide or better.

- The second approach combines the use of Interstate 80 median strip (widened) above Fairfield with the use of abandoned Sacramento Northern right-of-way in Fairfield and Southern Pacific and Santa Fe right-of-way below Fairfield to Richmond. This approach was developed to test potential capital cost savings associated with using highway versus railroad right-of-way.

- The third approach, between West Pittsburg and Sacramento (Rail PN), uses portions of the abandoned or little used Sacramento Northern right-of-way from West Pittsburg to Fairfield, crossing north of Travis Air Force Base to join the Southern Pacific right-of-way.

- The fourth approach (not designed) uses Santa Fe right-of-way between a proposed Antioch BART station and Stockton. From Stockton to Sacramento it utilizes the Southern Pacific right-of-way.

In each case, using railroad right-of-way with "live" tracks, careful location of the new track along with extensive use of an elevated configuration over existing railroad property permits new service to be introduced that would not interfere with existing or potential operations--sidings, grade crossings or mainline of the railroad. More detailed route descriptions are given below.

All the alternatives terminate with an outer BART station in the Bay Area, and at a proposed new railroad/bus station in Sacramento. The local transportation systems at the terminal ends of the routes are relied on to provide coverage to dispersed destination at terminal ends.

Transfer to the feeder/distribution systems is made via a cross-platform transfer at the terminals. At Richmond and West Pittsburg, for example, the rail station is above the BART station, permitting an easy escalator transfer. In Sacramento, a new station can be designed in one of several possible locations in concert with a new SRTD bus station and the proposed railroad museum. Both stations must have substantial parking facilities as well.

Intermediate station spacings were chosen with respect to the trade-off between total number of stops (coverage) and level of service (speed) over the trip. The number of stops was selected to maintain the stop speed potential of the technology and its acceleration/deceleration characteristics. The range of alternatives being tested will permit further refining or modification of the initial choice.

An additional criterion for choice of stops relates to the intercity service being provided. Route-stop-schedule combinations have been conceived so as not to compete with existing commuter services. Commuter-oriented service has not been a primary goal of the system being planned, although the higher speed systems will make some commuting possible from locations that are currently beyond the coverage of existing urban transit.

Vallejo, Fairfield and Davis have been chosen as intermediate stops as the major travel generators in the urbanized corridor between the Bay Area and Sacramento. Vallejo is common to both routes, which originate at Richmond. The Fairfield stop is planned to serve a dual purpose--serving the Fairfield area and as a transfer point for connections to Travis Air Field when and it if is expanded to become the Bay Area's fourth major jetport.

Station locations were chosen in order to maximize local access to and from the station, often in conjunction with locations where highways crossed the proposed alignment as in Fairfield and Davis. Some stations are downtown-oriented (Fairfield, Vallejo, Sacramento); others were located for their park-ride potential (nearness to major arterials or highways) or modal interchange possibilities such as the BART-oriented cross-platform transfer stations at Richmond and West Pittsburg or the Travis Air Terminal stop which also would serve the Fairfield area.

The routes and stops under consideration for each technology are listed on Figure 16. As indicated, this technology achieves an average speed of almost 100 mph, or 40 mph faster than conventional rail and over 45 mph faster than a bus with the same number of stops. The individual routes are described below.

Richmond/Sacramento Service (Rail RN)

The alignment for this alternative is shown on Figure 17, with the major profile configuration indicated.

The Richmond terminal is an aerial station located just above the BART's Richmond Station in order to provide an efficient vertical transfer. From the terminal station, the line would proceed north in an aerial configuration within the Southern Pacific Railroad right-of-way on the west side (to avoid spurs) to a point west of Garrity Creek, when the line would leave the Southern Pacific Railroad right-of-way and join the Santa Fe Railroad right-of-way and descend to grade. From there, the line would continue at-grade to Tennent Avenue where it becomes elevated and crosses over Tennent Avenue and Pinole Creek, and continue again at-grade, crossing under Hercules Street and San Pablo Avenue.

The existing bridge at Hercules Street would be replaced with a new structure while San Pablo Avenue Bridge would be modified. From there, the line would ascend to an aerial configuration, leave the Santa Fe Railroad right-of-way, and cross San Pablo Avenue and Franklin Canyon Road and enter the proposed widened median of Highway 80. The line would continue at grade in the median until the Cummings Skyway Interchange, where it would leave the median in the vicinity of San Pablo Avenue, rise and cross over the approach ramps of Highway 80 and cross Carquinez Strait with a new truss bridge west of the existing highway bridges.

After crossing Carquinez Straits, the line would enter a tunnel paralleling Highway 80, under Sonoma Boulevard to Chestnut Street. This Vallejo Tunnel would emerge just north of Chestnut Street, and the line would turn north rising to an elevated structure and enter the Southern Pacific Railroad right-of-way near Fifth Street. From there, the line would proceed north in right-of-way on the east side to the Vallejo Station located at either Georgia or Tennessee Street. The line would continue on an elevated structure to a point just north of Napa Junction, where it would cross to the west side of the Southern Pacific Railroad right-of-way and descend to grade. The line would then proceed east at-grade, cross over Highway 80 on a bridge, and continue at-grade until it crosses under Highway 21.

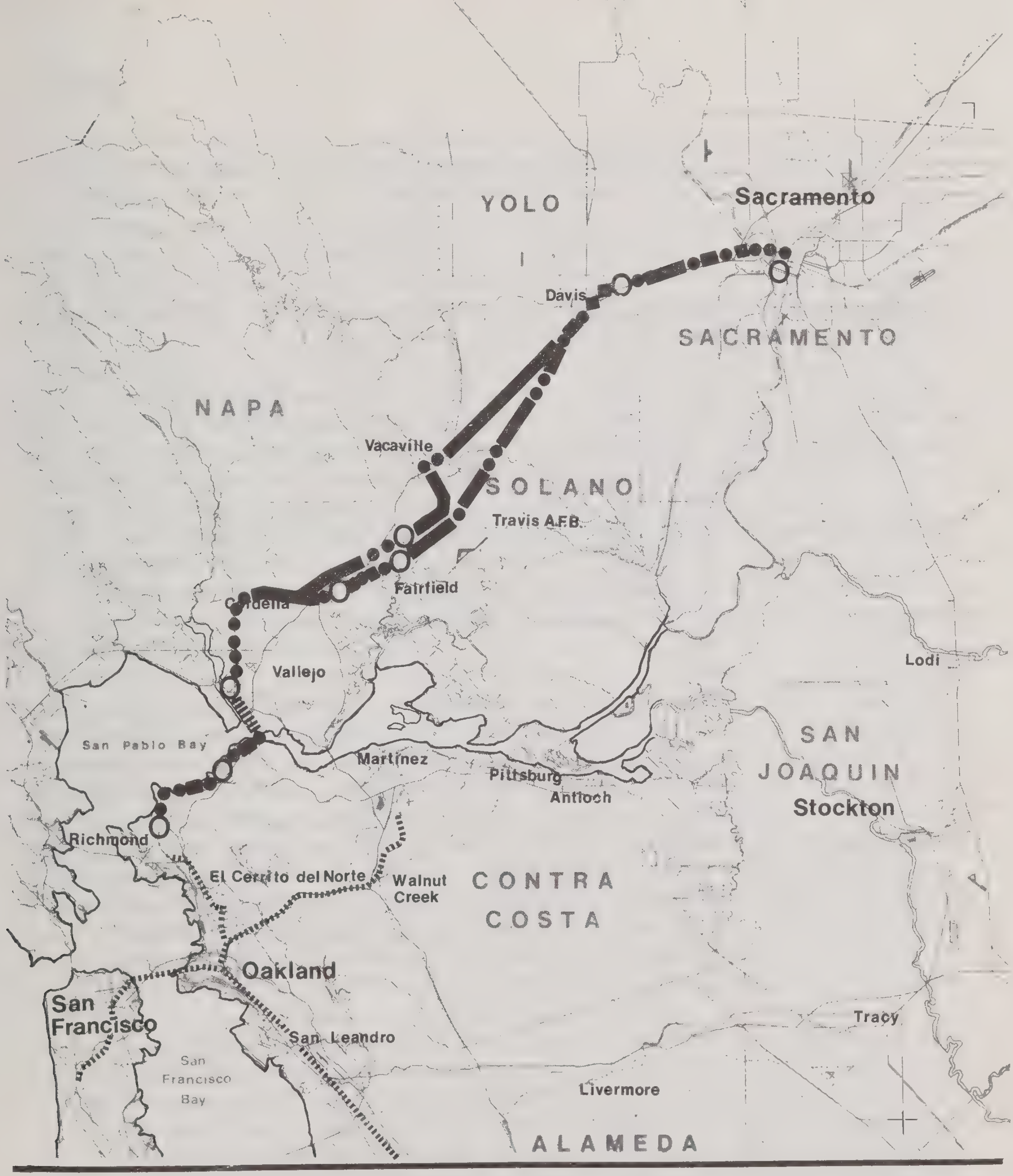
From Napa Junction to Cordelia Station, four new overcrossings would be provided for local roads. The line would continue in an aerial configuration

FIGURE 16

TURBOTRAIN ALTERNATIVES -- PERFORMANCE

			Distance (Miles)	Average Speed (mph)	Travel Time (min)	Peak Hour Headway (min.)	Off-Peak Hour Headway (min.)
RAIL PN	Richmond BART Station, 2nd and I, Sacramento	Vallejo Fairfield Davis	75	96	47	20	35
RAIL RN (Hwy)	Richmond BART Station, 2nd and I, Sacramento	Vallejo Fairfield Davis	77	96	48	20	35
RAIL PN	W. Pittsburg BART Station (Proposed) 2nd and I, Sacramento	Travis/ Fairfield Davis	55	97	34	20	35
RAIL AN	Antioch BART Station (proposed) Stockton Sante Fe Depot		32	108	18	30	60

Note: Preliminary assumptions for Peak = 5 hours, Off-peak = 12 hours.



KEY:

▬	GRADE	◆◆◆◆	OPEN CUT
●●●●	AERIAL	O	STATION
IIIIIIIIIII	TUNNEL	IIIIIIIIIII	BART

RAIL RN—NEW RAIL: RICHMOND/SACRAMENTO

BART R —BART: RICHMOND/SACRAMENTO

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TRANSIT IMPROVEMENT ALTERNATIVES

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Figure 17

through Cordelia Slough marshland through a short tunnel, and then above the railroad spur at Thomasson. From there, the line would descend to grade until Subeet, where it would ascend again to cross over the existing railroad spur and Cordelia Road. The line would descend again to grade and would leave the Southern Pacific Railroad right-of-way west of Ledgewood Creek, rise to an aerial configuration, cross over Pennsylvania Road and the Southern Pacific Railroad tracks to rejoin the Southern Pacific Railroad right-of-way at Suisun-Fairfield junction.

Fairfield Station would be located just north of Rio Vista Road (Highway 12). From there, the line would proceed east in an aerial configuration and within the Southern Pacific Railroad right-of-way, over the railroad spur to Travis Air Force Base, descend under the existing Air Base Parkway Overcrossing, which would be modified, and continue at-grade, crossing under the existing Sacramento Northern Railroad overpass which also would be modified. A new overcrossing would be provided for Peabody Road. After crossing Peabody Road, the line would ascend to an aerial configuration, crossing over the Sacramento Northern Railroad tracks to descend again to grade in the vicinity of Cannon. The line would continue at-grade, requiring the closure of Fry Road and the construction of a new frontage road on the north side connecting it to Meridian Road. Just west of Meridian Road, the line would ascend to cross over Meridian Road, Elmira Road, Hawkins Road and Lewis Road, to descend again to grade. New overcrossings would be provided for Fox Road, Batavia Road, Midway Road and Pitt School Road, while Weber Road would be closed. However, a new frontage road would be constructed on the north side connecting it to Batavia Road. The line would then ascend to an aerial configuration just before the Dixon City limit, crossing over Southern Pacific Railroad spurs and Pedrick Road and descending to grade. New overcrossing would be provided for Robben Road, west of Tremont Road and the Southern Pacific Railroad spur, descending again to grade. A new over-crossing would be provided for Davis Road.

After crossing over Highway 80 with a new bridge, the line would ascend to an aerial configuration through Davis. Davis Station would be located at the existing Southern Pacific Depot. From there, the line would descend to grade, crossing under the Mace Boulevard overpass, which would be modified, and generally follow the Southern Pacific Railroad track grade. Yolo Bypass would be crossed on aerial structure and embankment. The line would pass Highway 80 and rise over Harbor Boulevard paralleling the Southern Pacific Railroad tracks to the Sacramento River. The river would be crossed with a new truss bridge south of the existing I Street bridge. The line would then pass over both the Southern Pacific tracks and I-5 to an aerial station, located at one of several possible sites--north of I Street either east or west of the highway or south of the bridge west of I-5. Maintenance and storage facilities of 17 acres would be located between Davis and Sacramento.

The total distance between the Richmond and Sacramento terminals would be 75.2 miles.

Richmond/Sacramento Service--Modified Highway Alignment (Rail RN HWY)

This alternative, shown on Figure 17, would have the same alignment and stations as Alternative RAIL-RN from Richmond to the vicinity of Cordelia, where the alignment would leave the Southern Pacific RR right-of-way, ascend to an aerial configuration and enter the median of Interstate 80. The existing median would be widened to 74 feet, for a total length of 4.8 miles and four existing over-crossings would be rebuilt. The line would descend to grade and proceed northeast within the median up to a point south of West Texas Street interchange, where the line would enter a retained cut, leave the median, and occupy the abandoned Sacramento Northern Railroad right-of-way through Fairfield in retained cut configuration. New bridges would be provided for all street crossings in Fairfield and a parallel bikeway would be accommodated within the right-of-way. Fairfield Station would be located just north of Air Base Parkway.

From the station, the line would ascend to grade and continue northeast, occupying the Sacramento Northern Railroad right-of-way to Vacaville Junction. New overcrossings would be provided for Clay Bank Road, Cement Hill Road, and Peabody Road. After Vacaville Junction, the line would leave the Sacramento Northern right-of-way in order to employ a longer curve radius and continue northwest paralleling the existing Sacramento Northern Railroad track on the west side. New overcrossings would be provided for Peabody Road and California Drive. Near Alamo Creek, the line would ascend to an aerial configuration, turn northeast, cross over the Sacramento Northern track and rejoin the median of Interstate 80 just north of Mason Street over-crossing. The existing median would be widened to 74 feet for a total length of 16.3 miles. The line would descend to grade and continue east within the median up to the interchange with Route 113 west of Davis. There the line would descend to a retain-cut configuration. After crossing under Old Davis Road, the line would ascend to an aerial configuration, cross over Southern Pacific tracks and rejoin the Alternative RAIL-RN/BART R alignment west of Putah Creek. Maintenance and storage facilities would be located between Davis and Sacramento, where facilities would be provided for storage, servicing, light maintenance and overhaul, occupying an area of 17 acres.

The total distance between the Richmond and Sacramento Terminals would be 76.5 miles.

West Pittsburg/Sacramento Service (Rail PN)

The alternative assumes an extension (now under study by BART and MTC) of the existing BART urban service to a new terminal at Pittsburg or Antioch. As shown on Figure 12, the intercity connection would be made at the proposed BART West Pittsburg Station from an adjoining aerial station.

From the terminal station, the intercity line would curve northeast, cross the Mallard marshlands and ascend to cross Suisun Bay, with a tall truss bridge allowing required channel clearance. The line would continue northeast, occupying the abandoned Sacramento Northern Railroad right-of-way, through Chipps and Van Sickle Islands. The approaches to Suisun Bay Bridge would consist of tall elevated structures that would extend through Chipps Island, while from Van Sickle Island, the line would consist of low lying trestle-type structures that would extend past Montezuma in an effort to minimize ecological impact. From Montezuma, the line would continue to occupy the Sacramento Northern Railroad right-of-way on the west side of the existing track as it proceeds north at grade. Near Birds Landing Road, the line of the new alternatives would depart from the Sacramento Northern briefly to introduce a flatter curve, requiring an additional right-of-way, for a total distance of 1.4 miles. New road overcrossings would be provided at Montezuma, Dutton Road, Birds Landing Road, Shiloh Road, Little Honker Bay Road and Rio Vista Road (Highway 12). After crossing Rio Vista Road, the line would leave the Sacramento Northern Railroad right-of-way, turn northwest, and continue at grade, providing new road over-crossings at Lambie Road and Creed Road. At-grade configuration would continue to the Travis Air Force Base property line, where the alignment would descend to a tunnel (0.6 miles long) to cross under the landing strip (avoiding interference with instrumented landing systems) and to emerge north of Meridian Road. From there it would ascend to an aerial configuration to Travis Station just beyond Air Base property.

The line would continue in an aerial configuration, crossing over the Sacramento Northern Railroad track and North Gate Road, where the line would descend to grade. A new over-crossing would be provided for Cannon Road. After crossing Cannon Road, the line would curve northeast and join the Southern Pacific Railroad right-of-way north of Cannon, and continue north following the alignment described for Alternative BART-R and RAIL-RN. Maintenance and storage facilities would be located between Davis and Sacramento occupying an area of 14 acres.

The total distance between West Pittsburg and the Sacramento Terminals would be 54.9 miles.

Improved Passenger Train--Antioch/Stockton/Sacramento (Rail AN)

This alternative requires the construction of new tracks but follows the right-of-way of the Atchison, Topeka and Santa Fe Railway Co. from Antioch to Stockton as in Alternative RAIL-AE. This is shown in Figure 13. Given the small number of grade-crossings and the low traffic volumes an elevated structure is not necessary, although extensive fencing will be advisible in built-up areas. All grade-crossings will be protected. From Stockton to Sacramento, RAIL-AN, like AE, would also follow the Southern Pacific tracks.

Intermodal Coordination

The importance of convenient access between trip origin or destination and the intercity line-haul component of the intercity trip is increasingly recognized as critical to the preparation of any transit mode. Particularly for intercity line haul trips of less than one hour's duration, access to and from the system, plus waiting time, may take longer than the line-haul portion of the total trip. The poor feeder-distribution characteristics of existing intercity modes help explain their lack of attractiveness compared to the automobile.

Recognizing this problem, special attention has been given to interfacing the new line-haul system alternatives with the existing and projected local transportation systems. All the Improved Passenger Train alternatives have their Bay Area terminal at an easterly BART station, either Richmond, a projected BART station at West Pittsburg or Antioch. In addition, AC bus service has been assumed to have selected fixed route lines re-oriented to BART stations as well as their planned dial-a-bus system to improve access to the train.

At the Sacramento and Stockton ends of the intercity systems, most of the alternatives tie in closely with the existing and projected local bus systems. In Sacramento, several terminal options are near a projected new bus terminal at the west end of the city and the existing Southern Pacific Railroad station. Any of these terminals would aid in reinforcing projected historical area development, including a railroad museum. In addition, it would increase the accessibility to proposed urban development and renewal projects. Buses terminating at 3rd and J could easily swing by a train depot for feeder distribution purposes.

In Stockton there are several options. The existing Santa Fe depot at the west end of the city would obviate the necessity of constructing new

track into the city with the attendant grade-separation problems. However, this location has few highway and arterial connections and is not well located for multiple bus connections.

Location of the terminal at the Southern Pacific rail depot near Weber and Union would permit better connections to freeways (Route 4) and the local bus system which centers nearby.

In the smaller cities along the subcorridors between the Bay Area and Sacramento or Stockton which do not have good local bus systems, a new feeder-distribution bus system will be required in addition to park-ride facilities. Given the small size and low density of these areas and the relatively dispersed origins and destination of potential intercity travelers, a fixed route local bus system would not be an efficient solution. Therefore a demand-responsive dial-a-bus system has been assumed for those cities (Vallejo, Fairfield, Davis, Pittsburg, Antioch and Lodi). Such a system of small vehicles with a phone reservation system would provide an on-demand ride between home or other locations and the relevant intercity transit station. This type of system is described in the discussion of express bus improvement (Bus E) above.

At each station substantial park-ride space must also be provided. Existing bus and BART experience shows that as many as half the potential patronage may be expected to arrive by car.

In addition to this close physical coordination, joint fares and coordinated schedules must be brought into existence if maximum bus patronage is to be generated. Currently such arrangements are under consideration among the local transit systems (BART, AC and Muni) serving the Bay Area. This consideration of a "transit federation" approach can be extended to intercity transit as well.

Capital Costs

Comparative capital costs of Improved Passenger Rail are shown in Figure 18 and compared with the conventional rail alternatives.

Implementation Issues

In contrast to the conventional rail, construction, rather than train operations, is are the key institutional issue. New construction can be undertaken in such a fashion as to stay completely clear of existing Southern Pacific

FIGURE 18

CAPITAL COSTS -- IMPROVED PASSENGER TRAIN VERSUS CONVENTIONAL RAIL

Alternative	Comparative Costs ($ million)	Percent of Total Cost: Structures Stations	Vehicles	Operation Sub-systems [1/]
Conventional Rail (RE) Oakland-Sacramento	50	9 %	74%	17%
Conventional Rail (PE) W. Pittsburg-Sacramento	300	92%	3 %	5 %
Conventional Rail (AE) Antioch-Stockton-Sacramento	100	67%	16%	18%
Improved Passenger Train (RN) Richmond-Sacramento	700	92%	4%	4%
Improved Passenger Train (RN-Hwy) Richmond-Sacramento	800	91%	4 %	5%
Improved Passenger Train (PN) W. Pittsburg-Sacramento	500	94%	2 %	4%

[1/] Includes electrification, fare collection, controls, yards and shops

or Santa Fe operations and to have minimal impact on future development of facilities. It is assumed that a "master agreement", such as that developed by BART as the basis for its negotiations with railroads for acquisition or lease of railroad property in the Bay Area would be developed prior to undertaking detailed planning. Overall, this approach may be seen by the railroads as preferable to combined freight/passenger operations on existing track as it avoids interfering with freight operations. The construction of BART provides precedents for the lease of sale of air rights over railroad right-of-way.

BART CONTINUATION ALTERNATIVE

The construction of the Bay Area Rapid Transit System represents the first new regional rail rapid transit system constructed in the U.S. in over 50 years. The technology, developed in an intensive 10-year research and development program, represents the state-of-the-art in operating steel-on steel rapid transit systems--cars, controls, propulsion, suspension, braking, and guideway. Given the massive public investment in BART and its technology and the widespread public concern for its success, this study includes the feasibility of extending the BART system beyond the Bay Area to Sacramento and/or Stockton.

Present Service

BART provides radial transit service oriented toward suburban commutation to Oakland and San Francisco. Each of three East Bay Lines has the potential for 10 car trains every 4.5 minutes through the Trans Bay tube. The branch lines extend 10 miles north (Richmond) from the tube entrance and almost 20 miles northeast (Concord). The trip from downtown Oakland to Concord is 23 minutes (85¢) and 19 minutes to Richmond (50¢). Ridership on these lines is growing rapidly. On some lines, demand may out pace the short-term ability to introduce increased consists and frequency of service than now operated.

Potential as an Improvement Program

During the Schematic Phase (I), the major potential advantage of BART technology was seen as the possibility of a single no-transfer ride from (for example) Daly City, San Francisco, or Oakland to downtown Sacramento. The technology to achieve this would have to be compatible with the BART system--something that could only be achieved by using BART-type equipment since any equipment operating within the BART system would have to

have the same track gauge, third rail power pick-up, car dimension and types, acceleration/braking characteristics, control systems, etc., in order to be integrated with existing BART operations.

However, BART equipment is not compatible with existing railroad systems and, therefore, could not take advanatage of existing railroad track:

- BART track gauge is wider
- BART vehicles require third rail D-C power
- Safe operations, as well as the hazard of an electrified third rail, requires full fencing and separation of all grade crossings
- Passenger loading is from high platforms

Any alternative compatible with BART would, therefore, require investment in new track, structures, and appropriate control systems between the Bay Area and Sacramento (75 miles) or Stockton (32 miles).

Consideration was given to the development of a hybrid-urban/intercity BART vehicle. Such a vehicle must have both third rail and pantograph power pickup or operate with a self-propelled diesel/electric dual power configuration in order to avoid costs related to the rail. It would have to use BART train controls in the Bay Area and a simplified system, outside the present designed for the longer station spacing and longer headways appropriate to intercity service. It must have new power and/or gearing to retain the acceleration, braking, and power-to-weight characteristics of BART-type operation, but also achieve the higher top speeds and suspension required at over 100 mph for intercity operation. [1/]

This approach is not the extension of the BART system. An entirely new technology would have to be developed out of a substantial research and development effort. The likelihood of a reliable and economical product is inhibitied by the limited market as well as the technical complexity of the vehicle and the additional burdens it would impose on the BART system. In addition, the payoff is limited in the light of the other options available. A "hybrid" approach does not appear to offer a promising direction.

BART continuation alternatives considered in this phase, therefore, do not assume a complete new technology. They consist of extending the

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[1/] Current BART top speed at a maximum RPM is 100 mph. The manufacturer does not recommend operations at that speed.

existing technology and system including BART-type guideway to Sacramento and/or Stockton. Standard BART technology with an 80 mph top speed is assumed in order to take advantage of low capital cost of off-the-shelf vehicles and common maintenance facilities. This assumption gives the BART alternative a slightly lower top speed but better acceleration than conventional rail technology running on upgraded track although at a considerably greater cost, since new guideway is required. This cost is, in part, the result of technology requirements of the urban applications which are not necessary for intercity operation--third rail power pickup and vehicle system complexity. If this alternative proves promising on other grounds, modifications for overspeed between 80 and 95 mph should be considered.

Despite the cost disadvantage, which does not result in higher average speeds, the advantage of BART's ability to operate in a no-transfer mode into the Bay Area suggested it might offer service advantages. Phase II conceptual engineering studies, however, have indicated that through operations will introduce substantial new complications into an already complex operation configurations and control systems:

- BART consists are programmed by time of day. It appears that train consists (combinations of cars) coming from or going to Sacramento (or Stockton) would not be the same as standard BART consists. In order to match BART consists, intercity runs would have to run empty cars.

- At the same time, cars cannot be added or subtracted at current BART terminals or mid-line stations. This must be done in a yard where testing can take place before placing new makeups on the ready track. Passengers should be off-loaded for safety during coupling and uncoupling. BART cars are either "A" (with cabs) or "B" (passengers only) units. Non-yard make-up and ad hoc consists therefore become extremely difficult.

- Peak frequencies at Richmond for the two Richmond train types (Richmond-Freemont and Richmond-Daly City) combined with the Concord to Daly City trains will place the trains at close headways in each direction making it extremely difficult, if not impossible, to integrate a train arriving from Sacramento.

- Even at off-peak periods when time intervals between trains might make insertion possible, a nearly full train arriving in the Bay Area could become overcrowded in the run through the regular BART service area. Intercity peaks into the Bay Area will overlap with the last half of the regional evening commute peak. Intercity peaks out of the Bay Area would overlap with the morning commute peaks--assuming a one-hour Richmond-Sacramento run by BART. Some off-peak integration might be possible, however.

Thus, the major service advantage hoped for from BART technology--through non-transfer rides--cannot be achieved in peak periods except at the cost of vastly complicating BART's already complex operation and train control systems. Without non-transfer capabilities in peak periods, much of the BART technology benefits cannot be reaped from the substantial costs associated with BART type equipment with its urban-oriented performance capabilities--new track, third rail, complete separated grade-crossings, and continuous fencing.

In the off-peak and on weekends however, intercity BART trains may be integrated. During such periods, skip-stop operation and irregular consists might not pose a severe operational problem. Given that approximately 60 percent of the weekday intercity travel is not during the peak period, the BART alternative maintains some advantages.

Alternative Route/Stop Combinations

Two BART continuations to Sacramento have been examined. (A third, to Stockton, will be estimated if it appears from other tests to offer significant advantages over either conventional or improved rail technology). The routes followed are identical to Rail RN and PN. The Richmond BART Continuation Alternative (BART R) terminates in the Bay Area at the existing Richmond end-of-the-line station. The West Pittsburg BART Continuation Alternative (BART P) terminates at a proposed BART station at West Pittsburg currently under study by BART.

Each alternative is planned so that integrated operation into BART is possible in off-peak conditions. Provision is also made for cross-plafform transfer from adjacent elevated stations at peak conditions--similar to the rail alternatives.

- BART R follows the existing Southern Pacific and Santa Fe alignment to a new bridge over the Carquinez Straits. The route passes through Vallejo over a Southern Pacific Spur and then joins the Southern Pacific mainline right-of-way via Napa Junction and Cordelia. From Cordelia the alignment is within Southern Pacific right-of-way to a proposed Sacramento terminal. This terminal would be located at one of the several possible sites near old town--2nd and I, 4th and H, or east of the I Street bridge near the Southern Pacific Hospital.

  This alternative includes stops at Pinole, Vallejo, Cordelia, Fairfield, and Davis.

- BART P runs from a new BART station at West Pittsburg (proposed in a current BART extension study). This station would have both cross-platform and through operation capabilities. The alignment would cross the Carquinez Straits on a new bridge and then follow the little used Sacramento Northern right-of-way east of Travis Air Force Base to join the Southern Pacific mainline to Sacramento where station options identical to BART R would be obtained. Stops would include a station just east of Travis serving both the proposed fourth Bay Area jetport and the Fairfield area. The only other stop would be at Davis.

At Travis, the BART stop is designed to serve two functions:

- The station would provide a close connection to the proposed fourth major Bay Area jetport which may serve 6.5 million air passengers by 1985. A people-mover system could transfer air travelers from the BART station to the air terminal.

- The station would provide a park-ride location serving the Fairfield area. Shuttle bus connections to downtown Fairfield would also be necessary.

At 80 mph top speed, BART offers a travel time over the total trip between Bay Area BART terminus and Sacramento superior to all trains on existing tracks but slower than the turbo-train (Rail RN), which, like BART, requires new track and considerable grade separation. The comparison of speeds, travel times, and headways is shown in Figure 19.

FIGURE 19

BART AND RAIL ALTERNATIVES -- PERFORMANCE COMPARISON

Alternative		Intermediate Stations	Distance (miles)	Average Speed (mph)	Travel Time (min)	Peak Hour Headway (min)	Off-Peak Hour Headway (min)
RAIL RE	Oakland Sacramento	Richmond Martinez Fairfield Davis	87	61	86	20	40
RAIL RE[1/]	Oakland Sacramento	Richmond Martinez Fairfield Davis	87	68	76	20	40
BART R	Richmond Sacramento	Pinole Vallejo Cordelia Fairfield Davis	75	71	63	15	30
RAIL RN	Richmond Sacramento	Vallejo Fairfield Davis	75	96	47	20	40
BART P	W. Pittsburg Sacramento	Travis Davis	55	74	44	15	30

[1/] Assemes turbotrain rather than conventional diesel

Increased pressure will be placed on the limited park-ride facilities at Richmond since it is expected that as much as 50 percent of potential intercity riders will arrive by car. At West Pittsburg, careful consideration must be given to creating adequate park-ride capabilities.

In Sacramento, as with all the alternatives involving the construction of new rail, there are several terminal possibilities are close together in the west end of the city in conjunction with a new bus terminal, the historic area and various development plans. Each site possibility would permit a direct connection with local bus service.

With the BART Continuation Alternative, consideration has been given to a station design in Sacramento which would permit the extension of the system over Southern Pacific right-of-way through the city, operating as local rapid transit. However, the feasibility of this extension is not being addressed within the present study.

Intermediate stations must either be closely tied with local transit systems or supply local transit access where it does not now exist. This would include the BART R stations at Pinole, Vallejo, Cordelia, Fairfield, and Davis. Among these stops, only Vallejo currently has local transit service. At the others, new service must be established if the ridership potential is to be realized and full advantage of the elimination of car dependency is to be realized. Given the small size and low density of the suburbs surrounding these cities and the relatively dispersed origin and destination of potential intercity travelers, a fixed route local bus system would not be an efficient solution. Therefore, a demand-responsive dial-a-bus system has been assumed for these cities. Such a system of small vehicles with a phone reservation system would provide an on-demand ride between home or other locations and the relevant intercity transit station. This type of system is described in greater detail in the description of Express Bus E above.

Richmond/Sacramento Service (BART R)

The alignment for this alternative is shown on Figure 17, with the major profile configurations indicated.

The Richmond terminal is an aerial station located just above the BART's Richmond Station, in order to provide an efficient vertical transfer. The line would be extended south of the terminal station and connected to the existing BART tracks for possible through operation in off-peak periods.

From the terminal station, the line would proceed north in an aerial configuration within the Southern Pacific Railroad right-of-way on the west side to minimize the need to avoid spurs to a point west of Garrity Creek, when the line would leave the Southern Pacific Railroad right-of-way and join the Santa Fe Railroad right-of-way and descend to grade. The line would continue at-grade up to Pinole Station located opposite Pinon Avenue. From there, the line would continue at grade to Tennent Avenue where the line becomes elevated and crosses over Tennent Avenue and Pinole Creek, and to continue again at-grade, crossing under Hercules Street and San Pablo Avenue. The existing bridge at Hercules Street would be replaced with a new structure, while San Pablo Avenue Bridge would be modified.

From there, the line would ascend to an aerial configuration, leave the Santa Fe Railroad right-of-way and cross San Pablo Avenue, Franklin Canyon Road, and enter the proposed widened median of Highway 80. The line would continue elevated north to a point near California Street in Rodeo, where it would descend to grade. The line would continue at grade in the median until the Cummings Skyway Interchange, where it would ascend to an aerial configuration and leave the median in the vicinity of San Pablo Avenue, cross over the approach ramps of Highway 80 and cross Carquinez Strait with a new truss bridge west of the existing highway bridges.

After crossing Carquinez Strait, the line would enter a tunnel paralleling Highway 80 to Sonoma Boulevard, under Sonoma Boulevard to Chestnut Street. This Vallejo Tunnel would daylight just north of Chestnut Street, and the line would turn north, rising to an elevated structure and enter the Southern Pacific Railroad right-of-way near Fifth Street. From there, the line would proceed north in the Southern Pacific Railroad right-of-way on the east side to a Vallejo Station located near Georgia or Tennessee Streets. The line would continue on an elevated structure to a point just north of Napa Junction, where it would cross to the west side of the Southern Pacific Railroad right-of-way and descend to grade.

The line would then proceed east at grade, cross over Highway 80 on a bridge and continue at grade until it crosses under Highway 21. It then would ascend to an aerial configuration to the Cordelia Station at the Richie Road/Cordelia Road intersection.

From Napa Junction to Cordelia Station, four new overcrossings would be provided for local roads. Leaving Cordelia station, the line would continue in an aerial configuration through Cordelia Slough marshland

through a short tunnel and then above the railroad spur at Thomasson. From there, the line would descend to grade until Subeet, where it would ascend again to cross over the existing railroad spur and Cordelia Road. The line would descend again to grade and would leave the Southern Pacific Railroad right-of-way west of Ledgewood Creek, rise to an aerial configuration, cross over Pennsylvania Road and the Southern Pacific Railroad tracks to rejoin the Southern Pacific Railroad right-of-way at Suisun-Fairfield junction.

Fairfield Station would be located just north of Rio Vista Road (Highway 12). From there, the line would proceed east in an aerial configuration and within the Southern Pacific Railroad right-of-way, over the railroad spur to Travis Air Force Base, descend under the existing Air Base Parkway Overcrossing, which would be modified, and continue at-grade, crossing under the existing Sacramento Northern Railroad overpass which also would be modified. A new overcrossing would be provided for Peabody Road. After crossing Peabody Road, the line would ascend to an aerial configuration crossing over the Sacramento Northern Railroad tracks to descend again to grade in the vicinity of Cannon. The line would continue at-grade, requiring the closure of Fry Road and the construction of a new frontage road on the north side connecting it to Meridian Road.

Just west of Meridian Road, the line would ascend to cross over Meridian Road, Elmira Road, Hawkins Road and Lewis Road, to descend again to grade. New overcrossings would be provided for Fox Road, Batavia Road, Midway Road, and Pitt School Road, while Weber Road would be closed. However, a new frontage road would be constructed on the nroth side, connecting it to Batavia Road. The line would then ascend to an aerial configuration just before the Dixon City limit, crossing over Southern Pacific Railroad spurs and Pedrick Road and descending to grade. New overcrossing would be provided for Robben Road. West of Tremont, the line would ascend to cross over Tremont Road and the Southern Pacific Railroad spur, descending again to grade. A new overcrossing would be provided for Davis Road.

After crossing over Highway 80 with a new bridge, the line would ascend to an aerial configuraiton through Davis. Davis Station would be located at the existing Southern Pacific Depot. From there, the line would descend to grade, crossing under the Mace Boulevard overpass, which would be modified, and generally follow the Southern Pacific Railroad track grade. Yolo Bypass would be crossed on aerial structure and embankment. The line would pass Highway 80 and rise over Harbor Boulevard, paralleling

the Southern Pacific Railroad tracks to the Sacramento River. The river would be crossed with a new truss bridge south of the existing I Street bridge. The line would then pass over both the Southern Pacific tracks and several terminal sites are possible as discussed in the description of Rail RN. However, the 4th and H site offers the advantage of possible continuation through Sacramento as local rapid transit. Facilities would be provided for storage, servicing, and light maintenance, occupying an area of 13 acres between Davis and Sacramento with heavy maintenance performed in BART's East Bay facilities. The total distance between the Richmond and Sacramento Terminals would be 75.2 miles.

West Pittsburg/Sacramento Service (BART P)

This alternative assumes an extension (now under study by BART) of the existing BART urban service to a new terminal in Pittsburg or Antioch. As shown in Figure 12, the intercity connection would be made at the proposed BART West Pittsburg Station from an aerial station. The line would be extended west of the terminal station and connected to the proposed BART extension tracks.

From the terminal station, the intercity line would curve northeast, cross the Mallard marshlands and ascend to cross Suisun Bay, with a tall truss bridge allowing required channel clearance. The line would continue northeast, occupying the abandoned Sacramento Northern Railroad right-of-way, through Chipps and Van Sickle Island. The approaches to Suisun Bay Bridge would consist of tall elevated structures that would extend through Chipps Island, while from Van Sickle Island, the line would consist of low-lying trestle type structures that would extend past Montezuma in an effort to minimize ecological impact.

From Montezuma, the line would continue to occupy the Sacramento Northern Railroad right-of-way on the west side of the existing track as it proceeds north at-grade. Near Birds Landing Road, the line of the new alternatives would depart from the Sacramento Northern briefly to introduce a flatter curve, requiring an additional right-of-way, for a total distance of 1.4 miles. New road overcrossings would be provided at Montezuma, Dutton Road, Birds Landing Road, Shiloh Road, Little Honker Bay Road, and Rio Vista Road (Highway 12). After crossing Rio Vista Road, the line would leave the Sacramento Northern Railroad right-of-way, turn northwest, and continue at grade, providing new road overcrossings at Lambie Road and Creed Road. At grade configuration would (continue to the Travis Air Force Base property line, where the alignment would

descend to a tunnel (0.6 miles long) to cross under the landing strip (avoiding interference with instrumented landing systems) and to emerge north of Meridian Road from where it would ascend to an aerial configuration to a Travis Station just beyond Air Base property.

From there, the line would continue in an aerial configuration crossing over the Sacramento Northern Railroad track and North Gate Road, where the line would descend to grade. A new overcrossing would be provided for Cannon Road. After cross-ing Cannon Road, the line would curve northeast and join the Southern Pacific Railroad right-of-way north of Cannon, and continue north following the alignment described for Alternative BART-R and RAIL-RN. Maintenance and storage facilities would be located between Davis and Sacramento occupying an area of 12 acres with heavy maintenance performed in BART's East Bay facilities. The total distance between West Pittsburg and the Sacramento Terminals would be 54.9 miles.)

Intermodal Coordination

Critical to the service potential of BART Continuations is an adequate feeder/distribution service providing easy transfers to local transit and convenient park-ride conditions. In the Bay Area, the BART Continuation alternatives offer the advantage at off-peak and weekend periods of tying directly into the BART system. Non-transfer rides could be made at those times (11 of 17 operational hours assumed) to Oakland, San Francisco and Daly City. At the peak period, a cross-platform transfer would be required to a waiting BART train. At Richmond a choice could be made between a Daly City or Fremont train with an Oakland tranfer to the Concord line. West Pittsburg offers direct service to Daly City with a transfer in Oakland to the Richmond Line.

Today as much as 50 percent of existing BART riders access the system by automobile either as a park-ride or by "kiss-ride" (drop-off). This indicates the tremendous importance of establishing adequate parking lots convenient to both the BART Station and local streets and highways.

In addition to this close physical coordination, joint fares must be brought into existence if maximum intercity transit patronage is to be generated. Currently, such arrangements are under consideration among the local transit systems (BART, AC, and Muni) serving the Bay Area. This consideration of a "transit federation" approach can be extended to intercity service as well.

Implementation of joint fares between intercity and local transit is a complex affair. Automated ticket collection and accounting based on a user's credit card system are long-range possibilities. A short-range approach may be the use of a transfer issued by either the local or intercity carrier good for part or all of the local portion of the trip.

The competitive position of this mode as well as other technologies, would also be improved by the introduction of group fares and off-peak fares. This is particularly important given the fact that often the unit making a typical intercity trip is a group of more than one person. Without a group fare program, groups of more than 2 may find it cheaper to go by automobile.

Coordinated schedules is another important aspact of intermodal interface, since it can reduce waiting and transfer times which potential transit user find annoying. In the Bay Area, BART frequencies at the cross-platform transfer station assure a maximum waiting time half the off-peak headway. At intermediate stations, the demand-responsive local feeder transit will minimize waiting time to 10 minutes or less. Both of these assumptions constitute a dramatic improvement over the existing situation.

Capital Costs

The capital investment for the BART alternatives includes the cost of vehicles, new guideway (track), stations, maintenance and storage facilities, electrification, and controls, etc. It should be noted that the BART alignments are designed to be within 100-foot railroad right-of-way but on the side and elevated where necessary to avoid interfering with railroad operations. Complete grade-separation at street crossings is also assumed, as shown on Figure 20.

TRACKED-LEVITATED VEHICLE (TLV) ALTERNATIVE

Speed which can be achieved by ordinary trains is limited by the adhesion limits between steel wheels and steel rails. Higher speeds, such as those reached by the Japanese and more recent European high speed railroad experience, indicates that the price of these speeds is an entirely new alignment designed to close tolerances. The costs involved in 120 mph service coupled with the desire to push above 200 mph suggest the feasibility of jumping to a new technology.

Potential As An Improvement Program

At this time, the air cushion is an attractive and technically feasible means for levitating tracked vehicles (TLV) between 150 and 300 mph. This range

FIGURE 20

CAPITAL COSTS -- BART CONTINUATION ALTERNATIVES

Alternative	Comparative Costs ($ million)	Percent of Total Cost Structures Stations (percent)	Vehicles (percent)	Operating Sub-system 1/
BART Continuation from Richmond (BART R)	700	81	3	16
BART Continuation from W. Pittsburg (BART P)	500	82	2	16

1/ Includes electrification, fare collection controls, yards and shops

encompasses speeds above those at which traction wheels systems become expensive and below those at which aerodynamic resistance requires a prohibitive amount of power. Estimates of the limiting speed for steel traction wheels (on steel rails) ranges from 200-300 mph. At the high end of the speed range, the power needed to overcome aerodynamic drag has increased, roughly, as the square of air speed. This means that a 300 mph air-cushion vehicle will use 8 times the power of a 150 mph vehicle. Even though speed can be bought with power, other factors such as the ratio of payload to the weight of propulsion machinery will have to be considered.

Tracked, levitated vehicles (TLV) eliminate physical contact with a track and instead ride on an air or magnetic cushion over and/or around a fixed guideway for lateral constraint. The air cushion which eliminated physical contact permits greater speeds, with no track vibration, lower rolling resistance and less noise. At the same time, however, elimination of wheels eliminates friction propulsion and requires air thrust (turboprop or turbojet) or a linear induction motor (LIM) where the guideway itself becomes one component of an "unwound" electric motor.

The source of electric power for the LIM primary on high-speed TACVs presents a very difficult engineering problem. Ideally, this power would be generated on board the vehicle; however, at present the only practical prime movers at this power level are fuel engines, and their use is limited because of noise and air pollution. At present the most feasible concept is to provide the energy from wayside power rails through brush or non-contact collectors on the vehicle. Variable frequency LIM appear to offer substantial energy efficiencies.

In addition, the power required to maintain the air cushion is a problem. One of the major concerns in air cushion development has been the efficient use of compressor power. Although a large cushion-ground separation is desirable, a large gap requires a high volume of air from the compressor. Many schemes have been suggested for limiting leakage while still providing adequate ground clearance.

Magnetically suspended vehicles appear to be an alternative choice for speeds above those possible with rail systems. Magnetically supported vehicles will probably share air cushion's switching difficulty, but they may be even less sensitive to guideway irregularities than air cushion vehicles. Some proposed configurations have a levitation power requirement considerably less than that of air cushion systems. The lift propulsion elements of the vehicle could conceivably be combined into a single unit, simplifying vehicle design. A magnetically suspended vehicle would also be quieter. This concept is currently under development.

The prototype vehicle assumed in this study is a bi-directional entrainable tracked levitated vehicle which can operate in multivehicle consists with a top speed of 200 mph. "A" and "B" units with and without cabs will be 80-90 feet long and will look somewhat like current BART cars.

The double-tracked guideway is quite similar to BART--approximately 30 feet wide, whether on grade, in tunnel, or elevated. However, the high speeds involved require very flat, horizontal and vertical curves. At 200 mph the radius of curvature is between 2 and 3 miles, depending on superelevation. Thus, if speed potential is to be maintained, relatively straight alignments must be available. Therefore, the driving motivation behind the development of new guideway technology is cost. Tunneling is still a very high cost procedure and, because land acquisition in urban areas can be expensive, the elevated guideway is considered the most economical in terms of land use. Elevating the guideway also avoids the grade crossing safety problem and permits air rights use of existing transportation rights-of-way.

In addition to structural problems, other engineering concerns associated with TLV guideways include:

- Methods for switching vehicles off the guideway (for a high-speed, high-traffic line, this is a very significant problem).
- Methods for mounting and alignment-maintenance of the reaction rail (if a linear electric-motor is used for propulsion).
- Methods for providing wayside power at high voltage and high current levels.
- Air movement and resistance in tunnels.
- Air movement at wayside

Route/Stop Combination

The tracked air cushion technology is currently in development for an urban application in the U.S. DOT testing facilities. Intercity application has been under review since the Northeast Corridor Study. A bill currently awaiting Congressional action calls for serious study of a "West Coast Corridor" high speed ground transportation system, connecting the major cities from Mexico to Canada. The San Francisco-Sacramento route under consideration in this study would be a possible link in that hypothetical system.

The route selected connects the Bay Area with Sacramento and is designed to take advantage of the 200 mph potential of the technology. One stop is

projected in the Travis/Fairfield area serving both the Fairfield area and the projected 4th major Bay Area jetport adjacent to Travis Air Force Base. Terminals have been located such that the TACV route can be extended south to Los Angeles via the Central Valley or the coast route and north to Seattle or beyond. Consideration was given to a more easterly alignment in the Bay area, but such an approach appeared to have the major drawbacks that it would fail to compete effectively with air travel owing to the increase in access time from the population centroids of air travelers who are in San Francisco, Contra Costa, Alameda and Santa Clara counties. In addition, the ties with BART and local transit would be less direct.

Additional stops have not been considered since they would be so close together that the speed advantage of the large investment would be lost. The 200-mph TLV takes almost a minute and a half to accelerate to top speed.

In the Bay Area the route follows the Southern Pacific right-of-way with an Oakland stop adjacent to BART's West Oakland Station. In Sacramento, a park-ride station is located at the Interstate 80/880 intersection. The Travis/Fairfield station is just north of Highway 12 (Rio Vista Road). The need for fine tolerances in the guideway, the need to avoid grade crossings and the dictates of safety combine to produce a totally grade-separated guideway.

In order to maintain 200 mph speed a special alignment for this guideway was developed respecting the wide radius of curvature consistent with speed and comfort. This guideway does not follow existing transportation rights-of-way beyond Oakland owing to their high curvature. Minor modifications in existing rights-of-way would involve considerable disruption of existing development.

The route developed, therefore, combines subway and elevated construction in the East Bay along subaqaueous tube and deep bore tunnel before it reaches the relatively straight section of the Southern Pacific right-of-way between Fairfield and Sacramento. This route is described in detail below.

Oakland/Sacramento Service (TLV)

The alignment indicated in Figure 21 is planned so that it could become a component of a system that might ultimately run along the entire west coast from Tiujuana to Vancouver. The low tolerance for vertical curvature requires that this alternative remain on structure above grade rather than follow the ascending/decending profile used by the other alternatives to avoid spurs and local streets while minimizing costs.

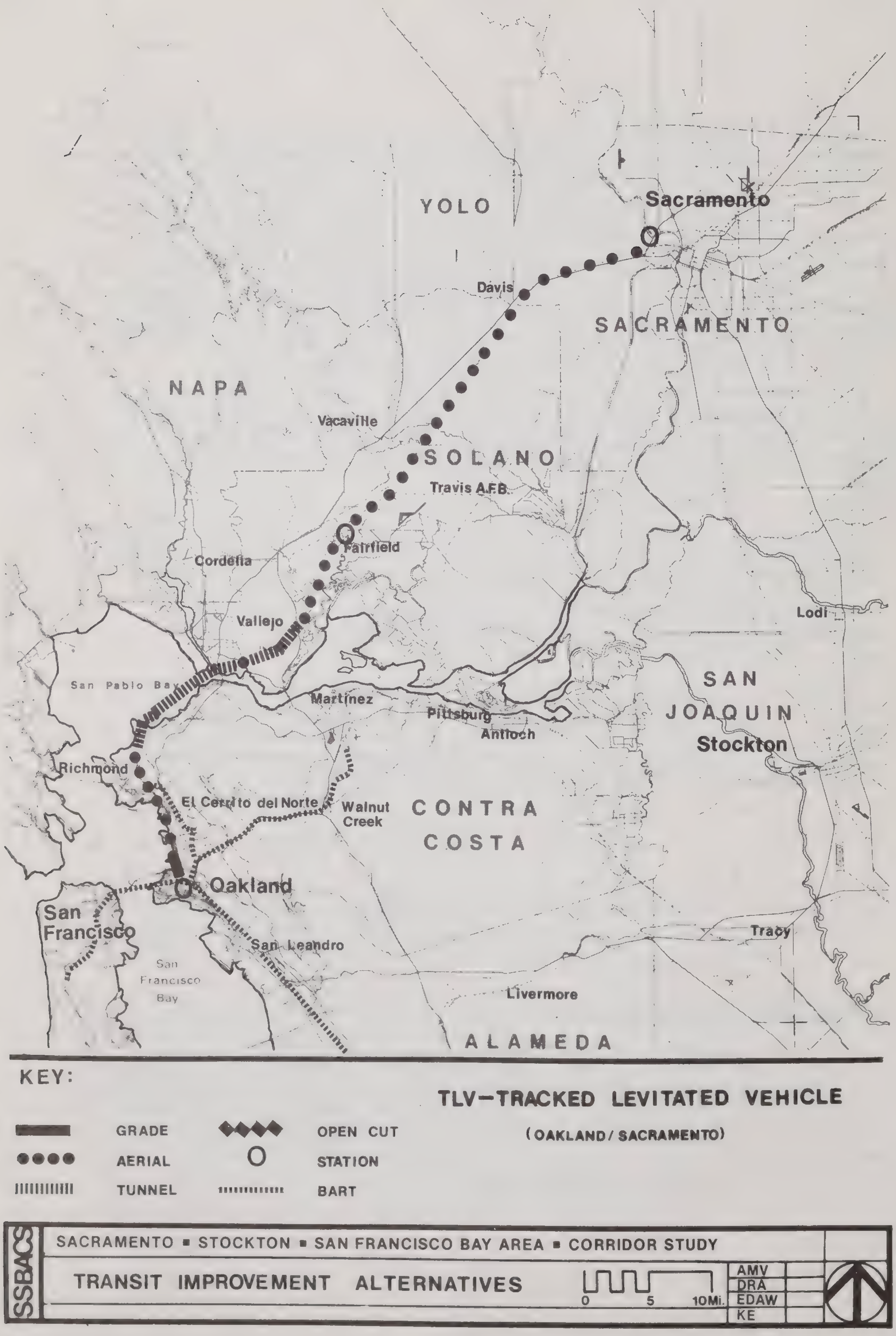
YOLO
Sacramento
Davis
SACRAMENTO
NAPA
Vacaville
SOLANO
Travis A.F.B.
Fairfield
Cordelia
Vallejo
Lodi
San Pablo Bay
Martinez
Pittsburg
Antioch
SAN
JOAQUIN
Stockton
Richmond
El Cerrito del Norte
Walnut
Creek
CONTRA
COSTA
Oakland
San
Francisco
San Leandro
San
Francisco
Bay
Tracy
Livermore
ALAMEDA
KEY:
GRADE
AERIAL
TUNNEL
OPEN CUT
STATION
BART
TLV—TRACKED LEVITATED VEHICLE
(OAKLAND/SACRAMENTO)
SSBACS
SACRAMENTO ■ STOCKTON ■ SAN FRANCISCO BAY AREA ■ CORRIDOR STUDY
TRANSIT IMPROVEMENT ALTERNATIVES
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Figure 21

The Oakland terminal would be a subway station, located in Cypress Street at the 7th Street intersection, adjacent to BART's West Oakland station.

From the terminal station, the line proceeds northeast in a subway under Cypress Street to 20th Street, where it would curve north under three city blocks to Wood Street and from there continues under the Southern Pacific Railroad yard tracks, and the interchange of Highway 80, 580 and M. After crossing the interchange, the line would ascend to an aerial configuration and continue north, paralleling Highway 80 on the west side. The line would cross over the interchange ramps at Powell Street, Ashby Avenue, University Avenue and Gilman Street. After crossing Buchanan Street, the line would leave the Highway 80 right-of-way, cross the mud flats, and join the Southern Pacific Railroad right-of-way, just north of Central Avenue.

From there, it would continue north on the west side of the Southern Pacific Railroad right-of-way in an aerial configuration up to Giant, where it would leave the Southern Pacific Railroad right-of-way and enter a tunnel beneath El Sobrante to a tunnel ventilation structure in San Pablo Bay.

The line would cross San Pablo Bay and Carquinez Straits in an 8-mile subaqueous tube to the ventilation structure at Semple Point. From there, the line proceeds in a deep bore tunnel (1.8 miles long) under the hills north of Glencove to emerge and cross Benecia State Recreation Area north of Southampton Bay in an aerial configuration. After crossing Highway 680 the line would enter a 5.4 mile deep bore tunnel under Sulphur Springs Mountain. This tunnel would daylight near Pierce and the line would continue in a aerial configuration crossing Highway 21 and the Southern Pacific Railroad tracks to proceed north and cross Suisun marshlands occupying the Southern Pacific Railroad right-of-way at the east side.

The alignment would continue through Suisun City to Fairfield Station, which would be an aerial station located just north of Rio Vista Road (Highway 12). From Fairfield Station, the line would proceed east in an aerial configuration, occupying the Southern Pacific Railroad right-of-way and crossing over the Air Base Parkway and Sacramento Northern Railroad overcrossings.

Near Cannon, there would be required a new right-of-way in order to employ a longer curve radius. After Cannon, the line would proceed within the Southern Pacific Railroad right-of-way on the south side, crossing Elmira and Dixon up to Putah Creek, just south of Davis, where it would leave the Southern Pacific Railroad right-of-way with a long curve radius, cross Putah Creek east of the Interstate 80/Davis interchange, cross Interstate 80, and rejoin the Southern Pacific Railroad right-of-way on the north side, west of Mace Boulevard.

Crossing of Interstate 80 and the Southern Pacific Railroad tracks would be accomplished with straddle bent structures. The line would proceed within the Southern Pacific Railroad right-of-way in an aerial configuration up to Interstate 880, where it would turn north, paralleling Interstate 80 to the West Sacramento Terminal, located near the Sacramento Avenue interchange. Maintenance and storage facilities would be located between Davis and Sacramento where facilities would be provided for storage, servicing, light maintenance and overhaul, occupying an area of 15 acres.

The total distance between Oakland and West Sacramento terminals would be 76.7 miles.

Intermodal Coordination

The enormous investment which a TLV system would represent would not be capitalized on if line haul performance is not adequately supported by a local feeder distribution system. The average traveler between the Bay Area and Sacramento is very likely to spend almost twice as much time getting to TLV terminals as riding the system itself.

In the Bay Area the terminal locations would permit a direct and common tie to BART's west Oakland station, thus tying TLV closely into BART as a distribution system. AC buses would also be rerouted to serve both BART and the intercity system at that point.

In Sacramento the station location is essentially a park-ride lot with a direct ramp access to both I-80 and I-880 serving the Sacramento region. The Davis/Sacramento express bus could be planned to make a stop at the TLV station or special shuttle service established to the capital area.

At Travis/Fairfield stop on Air Base Parkway, two separate local service functions are required. First, both park-ride space and local transit connections to the Fairfield area must be created. This local transit must be demand-responsive dial-a-ride system if it is to achieve effective coverage. Such a system is discussed in the description of the Bus E alternative. A special people-mover connection to the proposed Travis jetport must also be established. This must be a shuttle service capable of delivering people and baggage directly to the ticketing area. A small vehicle automated transit technology such as those in current airport use might be appropriate, given a daily demand of 5,000-25 percent of Travis' projected 6.5 million air passengers arriving or departing by transit.

Capital Costs

The comparative capital cost of this system is subject to considerable uncertainties owing to the lack of construction or operating experience. It is estimated at between $1.5 billion and $1.8 billion. Most of the cost (88 percent) is in structures including the 8-mile subaqueous tube and 7 miles of deep bore tunnel. Controls, wayside power, yards and shops, stations, etc. are 11 percent of the total and vehicles are about 1 percent. The 15-mile subaqueous tube and deep-bore tunnel account for more than half of the total cost. Further route studies might result in a lower cost alignment with equally low impacts if reduced performance is accepted.

SHORT-HAUL ALTERNATIVE

Short haul air service is a key transportation mode in California, with substantial activity by intrastate carriers. The level of air service offered is extremely high between the longer intrastate city pairs such as Los Angeles-Bay Area where flying is a close second to the automobile as the mode of choice. For the shorter trips of 100 miles or less, the advantageous air travel block speed of 350 mph is substantially offset by the travel time and cost currently incurred in gaining access to the major commercial airports. Using the air mode for a typical trip in the study area now involves 20-30 miles of access travel for a half-hour flight.

Reduction in access time through careful siting of supplemental airports or by improved ground transportation are imperative to realization of the full potential offered by short-haul air alternatives. Extremely complex and difficult practical and policy decisions will be required to achieve such a reduction. Serious consideration of such actions can be justified if a significant market can be demonstrated. Analysis of short-haul air, therefore is being focused on determining the patronage that might be expected if the access problem can be overcome.

Present Service

Service between Sacramento and the Bay Area is offered by both first level interstate and intrastate carriers as well as commuter airlines. Interstate carriers operate service to remain competitive and to support their long distance schedules, flying large multi-jet aircraft. Intrastate carriers typically operate 737 aircraft on a 25-minute schedule. While schedules vary during the "energy crisis," about 18 flights are offered daily nonstop between San Francisco and Sacramento, 7 daily between San Francisco and Stockton, 5 daily between San Jose and Sacramento and one between Oakland and Sacramento. Commuter service operates several one- and two-stop services in smaller aircraft. Last year, air carriers served about 800 passengers per day making intercity trips between Sacramento and the Bay Area. Over

one-half of these trips were business trips. An Additional 100 passengers made the trip for transfer purposes. Traffic between Stockton and the Bay Area was considerably less, owing to smaller populations and shorter distances involved.

Focus of Short-Haul Air Alternatives

Air travel for distances of 100 miles or less is severely hampered by access times and costs to the large and relatively remote airports despite relatively high average block speeds. The advantage of a short-haul air transportation system increases with the possibility of airports located in closer proximity to population and employment centers, either downtown or suburban. Using existing general aviation fields or establishing new airports for commercial service have been identified as a means of achieving improved access. In addition, reduction in passenger processing delay and runway or air traffic delays is also promising.

The forecasting effort in this study is focusing on the relationship of access time and costs to potential patronage. No attempt has been made to develop an optimum port location or to assess the feasibility or costs of new or improved ports. It should be recognized, however, that ultimately it is essential to relate (1) access to issues of port location feasibility and access systems (these are, in turn, affected by runway lengths and environmental questions), (2) operating and capital cost to aircraft and infrastructure costs, both of which vary with port locations. The basic issue is the degree to which a wider system of ports available for commercial use will lower access time and increase patronage while at the same time being achievable both physically and politically or not offset by higher operating and capital costs.

Alternative assumptions are made as to the operation of short-haul air service from existing airports, commercial and general, as well as the possibility of adding new port locations--both downtown and suburban. Two basic systems have been studied for short-haul operations--one using conventional or reduced take-off and landing equipment (CTOL or RTOL) and runways at existing commercial airports; the other using general avaiation or new port locations, shorter runways and advanced technology--short and quiet take off and landing equipment (STOL OR VSTOL).

"Existing Airports" System

The "existing airports" alternative assumes the use of the regional airport system as specified in ABAG's Regional Air System Study. The airports of the RASS system are:

- San Francisco
- Oakland
- San Jose
- Hamilton (Marin County)
- Travis (Solano County)

In addition, Sacramento Metropolitan is assumed to be available in Sacramento while San Jouquin County and Stockton will be served by Stockton Metropolitan Airport. These port locations are shown in Figure 22.

No new technology is assumed for this alternative. Current CTOL block speeds are employed and frequency is assumed at one-half hour. Airport access times reflect the existing ground transportation with the exception of the assumption that BART extensions have been made to both San Francisco and Oakland airports. Airport processing times have been reduced to a level consistent with commuter type operations--15 minutes.

"New Airports" System

The second system being tested is designed to simulate the substantial decrease in access time which might be associated with a more dispersed set of port locations. The feasibility of establishing a pattern of airports in the Bay Area combining existing commercial, general aviation and new ports into a rational regional configuration which minimizes access time (the prime rationale for short take off and land aircraft) is beyond the scope of this study. However, in respect to expanding commercial service, community and environmental problems pointed out by several recent studies include:

- community resistance to a facility used primarily by outsiders
- noise
- traffic generated
- inadequate clear zones
- airspace designed for general aviation

Travel advantages over other modes if demonstrated, are the countervailing benefits to the above problems. An advanced technology aircraft capable of operating from fields shorter than 3000 feet is assumed for this alternative. No difference in block speeds between this technology and RTOL or STOL technology were assumed for the 80-100 mile trip.

KEY:

▬▬	GRADE	◆◆◆◆	OPEN CUT
●●●●	AERIAL	O	STATION
IIIIIIIIII	TUNNEL	....	BART

SHORT-HAUL AIRPORTS

● AIRPORT LOCATIONS

SSBACS

SACRAMENTO ▪ STOCKTON ▪ SAN FRANCISCO BAY AREA ▪ CORRIDOR STUDY

TRANSIT IMPROVEMENT ALTERNATIVES

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Figure 22

The major difference between the two approaches being tested are the access time and costs and the fare levels reflecting differences in the operating costs of the two technologies. Actual additional port locations for commercial operation of advanced technology aircraft, have not been studied. The access time differential is being simulated by simulating a doubling of the number of existing commercial airport locations in the region.

Special attention will be given in a selected sensitivity analysis to the service improvements which might justifiably be underwritten with public support if short-haul air is to become an integral part of the multimodal regional transportation system. Such public actions might include special feeder bus and dial-a-bus service, fare subsidies, publically-sponsored trial services, etc. Determination of fares, discussed in the Patronage and Evaluation Report will also include an analysis of cost increases associated with loss leader subsidies, noise control and other indirect and direct operating costs associated with such a service improvement demonstration program.

COMPARATIVE SERVICE

The transportation level of service offered by each improvement under study is a composite of a series of mode and system-specific variables. These include total door-to-door travel time and out-of-pocket costs, such as fare and parking, safety, comfort, ease of transfer, schedules and frequency. Travel mode choice is made in a competitive context; it is therefore appropriate to compare key parameters among the alternatives. Among these, travel time and costs have been shown to be most important. Since 95 percent of the current travel is by auto and auto ownership is increasing as incomes rise, it is apparent that the service offered by a new mode must be compared with the automobile alternative available to most (but not all) potential intercity tripmakers.

Effects of fuel price changes, speed limit changes, and user costs are dealt with in the Patronage and Evaluation Report, since they are sensitive to varying policies, level of demand, and non-revenue financial sources as well as characteristics of the alternatives themselves.

Total Travel Time

Total travel times are made up of several components of a door-to-door trip. For an intercity transit trip, these typically include:

- Walk to access (feeder mode stop--if not park/ride or kiss-ride)
- Wait for feeder
- Ride to line haul station (or park)
- Ticketing and walk to platform and wait for line haul

- Ride line haul to station destination (including enroute stops)
- Walk to distributor and wait
- Ride distributor to destination stop
- Walk to final destination

Figure 23 illustrates and Figure 24 lists the total travel time estimates for a typical 95-mile door-to-door trip from a point near Union Square, San Francisco to the capitol in Sacramento, including the number of intermediate stops indicated. All rail trips use walk access (4 minutes to BART), BART ride to the intercity terminal at Oakland or Richmond and bus from the intercity terminal in Sacramento to a stop adjacent to the capital. Express buses are assumed departing from the Trans-Bay Terminal and short-haul air from SFO.

A non-stop automobile trip is compared with each. The comparative average speeds for ground models on the line-haul portion of the trip range from 60 mph for auto to 165 mph for TLV. These averages reflect both the maximum speed and number of intermediate stops indicated in Figure 25. However, the total door-to-door travel time also has substantial access mode and waiting time components which dilute the advantages of high line-haul speeds.

The total travel times appear to cluster in 3 ranges. Tracked Air Cushion Vehicle and short-haul air with improved access, alternatives with extremely large capital and operating costs, and most difficult implementation problems achieve door-to-door travel times of 65-75 minutes or less. Turbotrain short-haul air with existing airports and automobile are in the 95-105 minute range. Express bus, BART continuations and conven tional rail are in the 120-125 minute range.

For the TLV, assuming (generously) a one-quarter-mile walk to BART, a 15-mile BART ride to Oakland, a waiting time equal to half the line-haul peak headway, coupled with a 3-minute feeder bus wait and a 3-mile feeder bus trip and a quarter-mile walk in Sacramento--these non-line-haul components consume 49 minutes of a 72 minute trip, or 60 percent of the total travel time.

Given the extremely high costs of structured guideway and tunneling, a high importance placed on travel time reduction and the potential effects on air travel congestion reductions are required to justify serious consideration of TLV in the short run. Indeed, the travel time reductions terminal-to-terminal are dramatic. The operating configuration described above would result in a 28-minute travel time between the Bay Area and Sacramento. The Travis stop could be reached from either terminal in approximately one-half that time. The average speed would be 165 mph. For comparative purposes, the travel time from the West Oakland BART station to Sacramento for

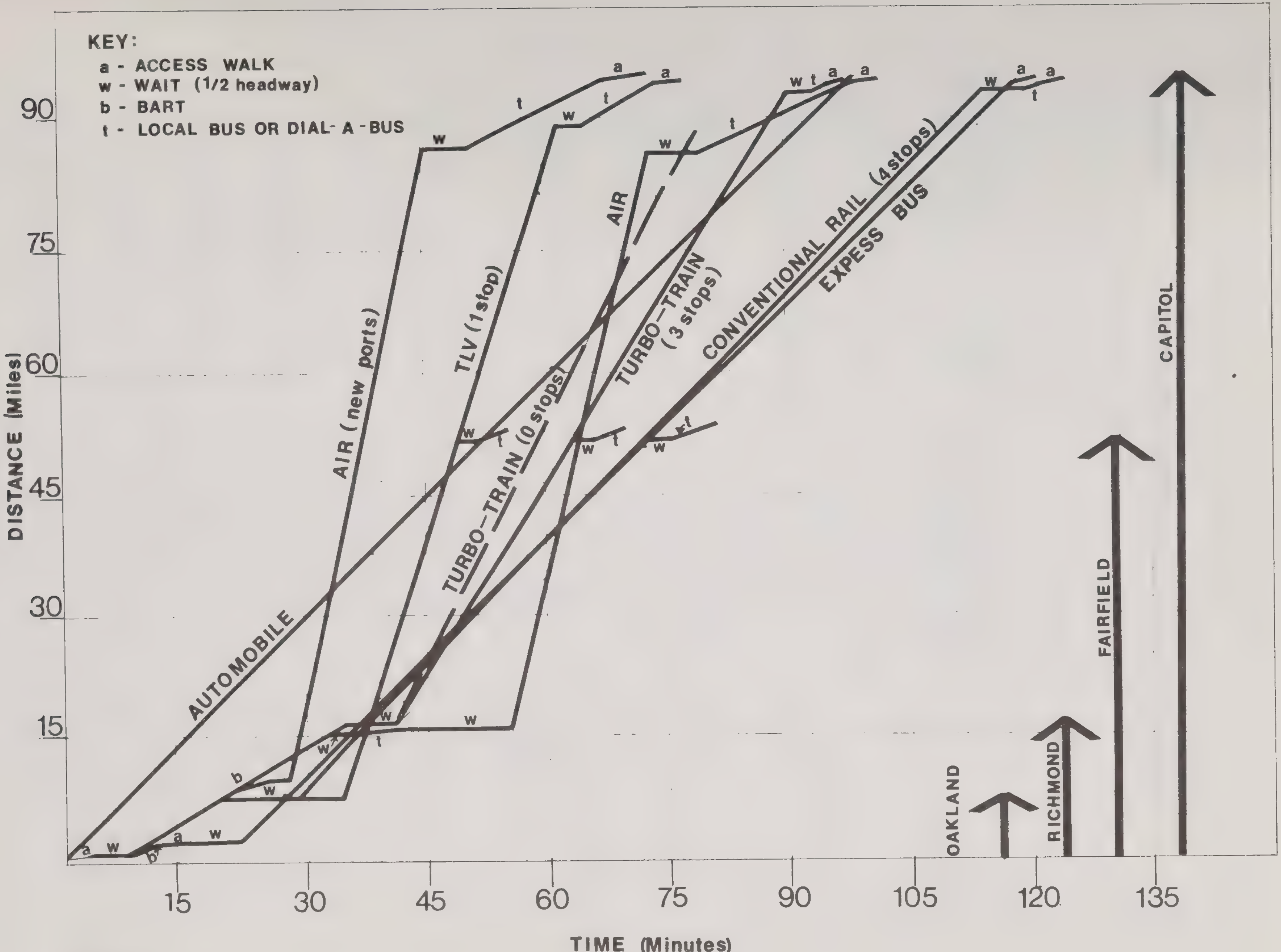

Figure 23

Door-To-Door Travel Time Distance Comparison

FIGURE 24

DOOR-TO-DOOR TRAVEL TIME COMPARISON

Alternative	Maximum Speed (mph)	No. of Stops	Peak Hour Headway (min)	Door-to-door Travel Time (Min.)
Express Bus	65 1/	0	20	121
Conventional Rail from Richmond	90	4	20	124
Turbo train from Richmond	120	3	20	103
BART Continuation	80	5	15	119
Tracked Air Cushion Vehicle (Oakland-16th Street)	200	1	40	77
Short-Haul Air (SFO)	350	0	30	108
Automobile	65	0	--	103

1/ Non "fuel crisis" speeds.

FIGURE 25

IMPROVEMENT PROGRAMS

Alternative	Terminal Stations	Intermediate Stations	Length Miles
Express Bus-Bay Area/Sacramento (Bus E)	Several Routes	Differ	70-90
Express Bus-Bay Area/Stockton (Bus S)	Stockton Bus Station	Livermore Tracy	
Express Bus-Stockton/Sacramento (Bus S)	Stockton Bus Station Sacto Bus Station	Lodi	50
Conventional Rail-Oakland/Sacramento (Rail RE)	Oakland 16th St. Exist. S.P. Railroad Station Sacramento	Richmond Martinez Fairfield Davis	57
Conventional Rail-Antioch/Stockton (Rail AE)	Antioch BART Station, Exist. Santa Fe Railroad Station Stockton		32
Conventional Rail-Stockton/Sacramento (Rail AE)	S.P. Station Stockton S.P. Station Sacramento	Lodi	48
Conventional Rail-W. Pittsburg/ Sacramento (Rail PE)	W. Pittsburg BART Station, S.P. Station Sacramento	Travis Davis	55
BART Continuation-W. Pittsburg/ Sacramento (BARTP)	W. Pittsburg BART Station, 2nd & I, Sacramento	Travis Davis	55
BART Continuation-Richmond/ Sacramento (BART R)	BART Station at Richmond 2nd at I in Sacramento	Pinole Vallejo Cordelia Fairfield Davis	75
Turbotrain-W. Pittsburg/Sacramento (Rail PN)	W. Pittsburg BART Station, 2nd & I, Sacramento	Travis Davis	55
Turbotrain-Richmond/Sacramento (Rail RN)	BART Station at Richmond 2nd at I in Sacramento	Vallejo Fairfield Davis	75
Turbotrain-Richmond/Sacramento (Rail RN Hwy)	BART Station at Richmond 2nd at I in Sacramento	Vallejo Fairfield Davis	77
Turbotrain-Antioch/Stockton	BART Station Antioch, Santa Fe Station Stockton		33
Turbotrain-Stockton/Sacramento	S.P. Station Stockton S.P. Station Sacramento	Lodi	46
TLV (TACV)-Oakland/Sacramento	Oakland Cypress St. at 7th St. Sacramento Ave. Interchange at I-880	Fairfield	77
Short-Haul Air	Several		80-90

systems studied are shown in Figure 26. While these comparisons are not strict (since different stop mixes are involved) they show order-of-magnitude differences.

For a turbotrain ride, over the total door-to-door San Fransisco-Sacramento trip, the walking plus BART access time to Richmond, plus the waiting time and access times in Sacramento, etc., consumes a nearly equivalent time but is coupled with a 47--instead of a 28--minute line-haul ride, this time, however, included 3 stops, which penalize the turbotrain roughly 9 minutes. The dotted line on Figure 23 shows a nonstop turbotrain time for comparison. The nonstop automobile can match the three-stop turbotrain on a door-to-door basis to Sacramento despite a line-haul speed disadvantage of 35 mph.

For the automobile, no access modes, transfers or annoying waits are necessary. Against such formidable opposition, transit must offer equivalent comfort plus on-board amenities, "Leave the driving to us" reliability, and competitive out-of-pocket costs, including parking.

For express bus and conventional rail, the comparison is equally unfavorable. Express bus with no stops, while offering automobile speeds on the freeway, has associated considerable access and wait times with it. For the typical trip under discussion, half-headway waiting times, walking times and local transit access add over one-half hour to the door-to-door travel time. In an effort to reduce those times, new bus routes have been added to further disperse Bay Area terminal locations.

For conventional rail, however, the points of local access to the line-haul system are limited. In each case, auto or local transit transfers are required for most trip-makers. The cost of this accessing in time and money is not recovered in line-haul speeds in comparison to the automobile. On a travel time basis alone, for most trips, the train and bus will not be competitive with the automobile.

Current short-haul air travel is the prime example of high line-haul speeds combined with very large access times and costs. Without several new airports reducing access time, the airport access time (even assuming a BART airport connection) is over one-half hour at the Bay Area end of the trip. Combined with a similar problem in Sacramento or Stockton, air travel times are about equal to automobile travel time. With an assumed 40 percent reduction in access time in the Bay area, the air travel mode becomes more competitive with the automobile.

FIGURE 26

COMPARATIVE TERMINAL-TO-TERMINAL TRAVEL TIMES

Alternative	No. of Stops Beyond Richmond	Top Speed (mph)	Travel Time (Min)
RE-Conventional Rail (Diesel-electric on up-graded tracks)	4	90	86
RN Turbotrain on new track	3	120	69
BR BART Technology	5	80	88
TLV (Tracked Levitated Technology)	1	200	28
Bus	5	65	112

Note: Times for alternatives except TLV include 22 minutes BART ride W. Oakland to Richmond.

Access-Egress Component

The above comparisons are for relatively long trips with a large feeder component illustrating the intermodal comparison at its extreme. For trips from the East Bay to Sacramento or Stockton, the feeder times to rail and air terminals would be slightly reduced on average since these line-haul modes terminate in the East Bay.

Park-ride or kiss-ride access would result in slightly reduced access times for longer access-trips where local bus coverage is less complete. In addition, auto access eliminates local transit waiting times. The no-transfer/no-waiting advantages of the auto are more pronounced for the shorter trips such as San Francisco to Fairfield where access and waiting times make up a larger component of the total travel time--over half.

Figure 27 shows graphically the access/egress component of total door-to-door travel time. While block times decrease gratifyingly with increased trip speeds, total door-to-door times do not vary as much because of the wide variation in feeder/distribution capability. A doubling of top speed from bus to turbotrain achieves only a 15-minute total travel time decrease. An additional nearly doubling in top speed to TLV only achieves a 30-minute further decrease. The advantage of short-haul air in terms of total door-to-door travel is clearly lost without a substantial improvement in access.

It is clear that the advantage of dramatic increases in speeds of line-haul services are not captured if access and waiting times are extensive. Much of the intercity transit speed advantage over the automobile is lost in three separate waiting times--for BART, for the line-haul mode and for the local bus at Sacramento. Behavioral research has indicated the consumers find this waiting time expecially annoying, weighting it more than twice as heavily as time actually traveling in their trip-making decisions. Therefore, the program packages have been designed to minimize these times--by establishing convenient intermodal transfer points with local transit for feeder distribution at terminal stations, by increasing the number of terminals, by specifying the need for demand-responsive local transit at intermediate stations.

Travel advantages to the through traveler are also lost with each intermediate stop. This detracts from its competitive advantage. These stops, however, increase the potential travel market and they broaden the area served new transit. Planning the optimum service involves a trade-off between these factors.

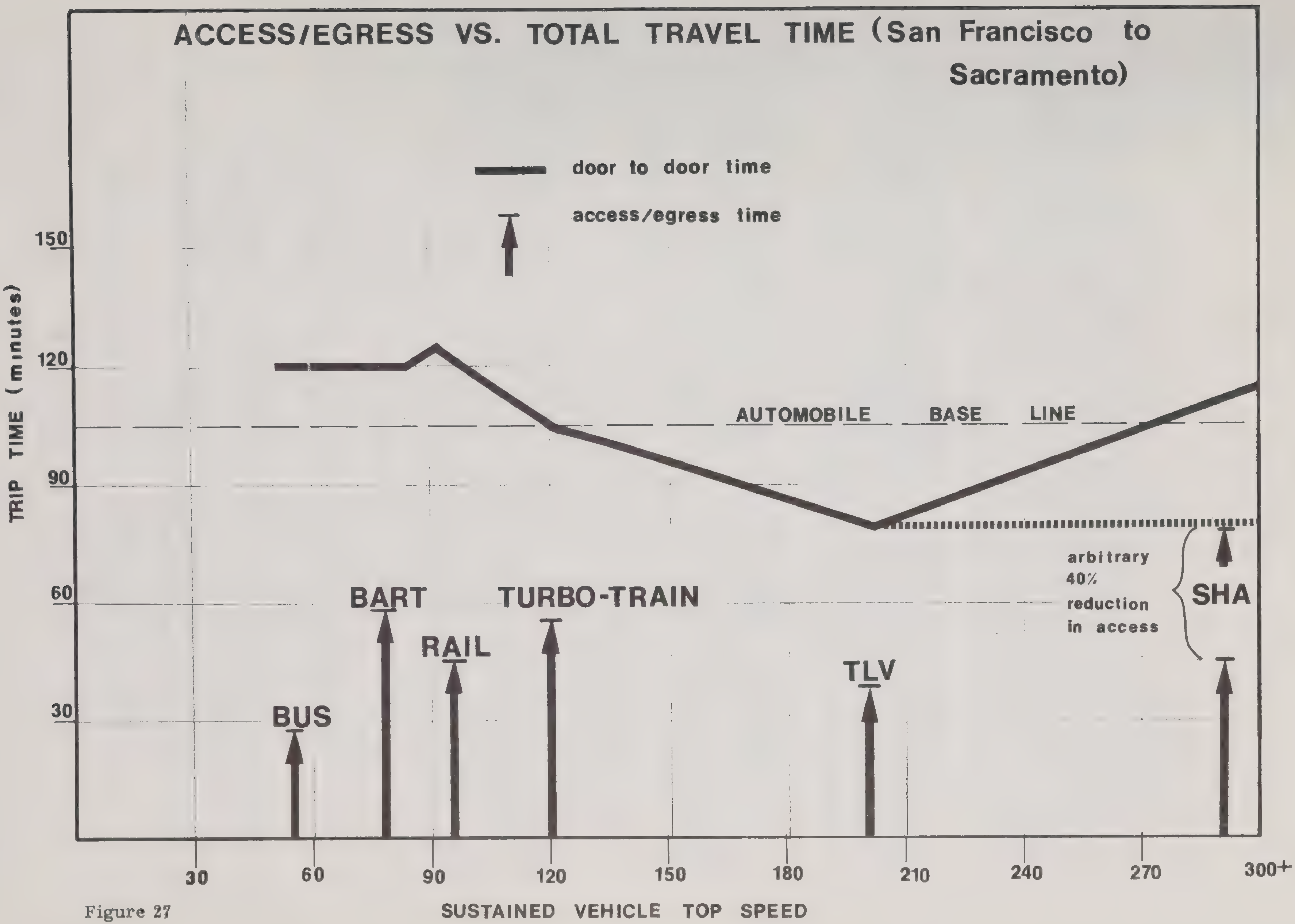
ACCESS/EGRESS VS. TOTAL TRAVEL TIME (San Francisco to Sacramento)
door to door time
access/egress time
TRIP TIME (minutes)
150
120
90
60
30
AUTOMOBILE BASE LINE
BART
TURBO-TRAIN
RAIL
BUS
TLV
arbitrary 40% reduction in access
SHA
30
60
90
120
150
180
210
240
270
300+
SUSTAINED VEHICLE TOP SPEED

Figure 27

CAPITAL COSTS

The potential of the alternative systems under investigation is being evaluated in a multidisciplinary manner, including its transportation benefit as well as its environment and economic consequences. The conceptual engineering and patronage forecasting provides the required system and service specifications to permit those evaluations to be undertaken. Since a wide range of capital investment is associated with each alternative, the costs of constructing and operating each alternative requires attention.

The economic evaluation of the alternatives, therefore, is being undertaken, responding to site-dependent data such as alignment profile and construction specifications as well as to service and operations dependent data such as ridership and engineering cost analysis, and finally to various methods of financing, both revenue and non-revenue.

The capital costs have been developed for the systems tailored to the preliminary service specifications of Figure 2. It must be recognized that this comparison is not a uniform one since the systems themselves offer varying coverage and speeds. In addition, not all the systems require construction of new guideway or stations, but use existing track (with modifications) or highway. A final economic evaluation including operating cost/revenue comparisons is presented in Patronage Forecast and Evaluation , normalizing the cost comparison by speed, coverage and patronage.

The conceptual engineering was carried using preliminary profiles and alignments on USGS 7.5-minute quads. Typical structural sections for various foundation conditions, linear and unit-related quantities were developed for estimating purposes. Unit prices were drawn from recent experience with similar construction. Power, controls and testing costs were drawn from BART and rail data and U.S. DOT publications.

Construction costs were estimated in the following categories:

- Ways and Structures--based on typical sections for given technology, length of corridors, foundation conditions and route-foot prices from U.S. DOT figures.
- Stations--based on (2) 15 foot wide platforms with varying platform lengths.
- Yards and Shops--based on a 12-17 acre site with varying equipment components by technology.
- Landscaping--based on a route-foot basis for preparation of similar installations.

- Fare Collection--based on BART for automated system (BART only); turnstiles assumed for other alternatives except bus.
- Propulsion Power--based on sample estimate for typical segment indicating number and type of substations, feeders, power rail, etc.
- Control and Communications--based on BART, conventional rail. TLV based on FRA data.
- Systems Testing--based on a route-foot basis referring to assumed similarities with BART and other new rail installations.
- Engineering and Management--based on degree of repetitive efforts, constraints, degree of tolerance, and state of technology development. 12-15 percent factors were applied.

As appropriate to conceptual engineering a conservative contingency factor was applied to all systems. This varied from 25 percent for the BART-based system to 30 percent for all other technologies except use the conventional equipment on modified existing facilities which had a 35 percent factor. Totals were rounded up to the nearest $10 million. Figure 28 shows the comparative capital cost breakdown.

It should be noted that none of the system costs include property acquisition for right-of-way. Many of the systems utilize railroad right-of-way now in single ownership. This property has unique value because of its continuity. At the same time, however, the "value" of this land is of the nature of economic rent and as such, payment can only result from bargaining. Recent prices for railroad property in the East have varied greatly. The negotiation context would depend on the current economic and political situation, the actors involved, as well as possible arbitrated settlements in the event that the state or Amtrak exercised eminent domain powers. More important, it is not clear that outright acquisition in fact would be either possible or desirable. Nor is it clear that such an action might not benefit the railroad itself. It is also possible that property leases or purchase of aerial and grade easements would be a more acceptable and economical arrangement.

Two types of systems investment are clearly evident--those with large investments in fixed facilities as a proportion of a substantial total cost-- TLV, Turbotrain on new rail and BART on turborail and those with lower capital costs of which a large proportion is vehicles--bus and conventional rail on existing track.

FIGURE 28

COMPARATIVE CAPITAL COSTS

Alternative	Comparative Cost In Millions of $	Percent of Total Cost: Structures, Stations	Operational Sub-Systems[1/]	Vehicles
Express Bus-All Routes (Bus E & Bus S)	9	30%	5%	65%
Conventional Rail-Oakland/ Sacramento (Rail RE) (Upgraded Track)	50	9%	17%	74%
Conventional Rail-Antioch/ Stockton (Rail AE) (Upgraded Track)	50	67%	16%	17%
Conventional Rail-Stockton/ Sacramento (Rail AE) (Upgraded Track)	50	67%	16%	17%
Conventional Rail-W. Pittsburg/Sacramento (Rail PE) (Upgraded Track)	300	92%	5%	3%
Turbotrain-W. Pittsburg/ Sacramento (Rail PN) (New Track)	500	94%	4%	2%
BART Continuation-W. Pittsburg/Sacramento (BART P)	500	82%	16%	2%
BART Continuation-Richmond/Sacramento (BART R)	700	81%	16%	3%
Turbotrain-Richmond/ Sacramento (Rail RN) (New Track)	700	92%	4%	4%
Turbotrain-Richmond/ Sacramento (Rail RN Hwy) (New Track)	800	91%	5%	4%
TLV (TACV)-Oakland/ Sacramento (TLV)	1,500 - 1,800	88%	11%	1%

1/ Communications, controls, electrification, fare collection, yards, shops

III.

III. IMPACTS

This section is a description of the major non-transportation impacts associated with the alternate intercity transportation improvement programs. Material in this section has been developed from conceptual engineering using a variety of secondary data sources and judgment derived from analogous projects in other regions. Consistent with the level of specificity developed in the study, key environmental and economic impact categories were identified. They included:

- Direct environmental (ecological) impacts
- Energy utilization
- Noise pollution
- Regional economic structure
- Corridor economic structure
- Local economic and development impacts

DIRECT ENVIRONMENTAL IMPACTS

A preliminary environmental reconaissance and impact analysis for the routes and transportation improvement alternatives under consideration has been developed. This analysis built on the study region environmental review carried out during Phase I. The Phase I review served four major purposes:

- Understanding of major environmental values and constraints from the point of view of route location.

- Assist in modification of alternative future growth patterns in terms of environmental holding capacity.

- Develop general background to judge potential environmental impacts of alternatives.

- Evaluate regional environmental goals, policies and objectives.

Toward this end, development constraints were developed from the following factors:

- Existing urban areas and military lands.
- Parks and wildlife/game reserves.
- Land over 1000 feet above sea level.
- Marshes and salt evaporators.

- Low mountains and hill areas
- Open surface water and mud flats.
- Faults and fault zones.
- Flood plains and flood channels.
- Zones in which some areas may flood.
- Zones of most abundant landslides.
- Soil erodibility very severe.
- Areas of soil subsidence hazard.

During Phase II, additional data were developed to include rare and endangered species areas and environmental constraints regarding wildlife habitat. These are shown in Figure 36. Using the Phase I and Phase II data, the development constraints were summarized and mapped. The additional environmental information, along with the zonal analysis of future socioeconomic activity patterns, permitted the final revision of Alternative Futures. This is discussed in a following section. The environmental constraint material also reinforced other study conclusions based largely on transportation and regional planning policy, which lead to a decision to place transportation improvements largely in existing transportation corridors.

Impact Assessment of Alternative Improvement Programs

Using the conceptual engineering information, a preliminary assessment of the direct impact of the construction of the alternative improvement programs on the natural and man-made environment has been carried out. The decision to locate alignments largely within existing transportation corridors has resulted in eliminating major relocation problems and most ecological impacts associated with construction in previously unimpacted areas. However, the conversion of existing transportation rights-of-way for new modes or the increasing intensity of their use has associated impacts, as does the establishment of new stations. Right-of-way impacts are addressed below. Station impacts are discussed in another section of this report.

Express Bus (Bus E and Bus S) -- All bus alternatives operate on existing expressways. No new highway construction is assumed. Bus transfer points at terminals are on existing BART or bus terminal property. Bus pad construction at highway interchanges is proposed for unused land adjacent to the freeways.

Conventional Rail (Rail RE) -- The use of diesel electric trains on the existing Southern Pacific and Sante Fe tracks does not itself require track construction

and will have no direct impacts. Stations must be constructed at Martinez and Fairfield. Neither station or parking area is significantly large to cause either dislocation or runoff impacts. The prime impact of this alternative will be the noise and visual disruption of an increased number of train operations over this line both on residential environments (in Davis) and on wildlife and the rural character of the Suisun marsh.

Improved Passenger Train/BART Continuation (Rail RN, BART R)

This alternative involves new construction of tracks and supporting structures. Most of the alignment is within existing railroad right-of-way. No residential or commercial property dislocation is involved. Part of the alignment is within highway right-of-way. To achieve the appropriate median width, the highway in those sections must be widened by 74 feet. There are limited impacts in those areas, primarily on parking and access areas of a few commercial structures immediately adjacent to the highway.

This alignment is described in detail in another section. Major impacts are summarized below:

- The Richmond Station is elevated above the Richmond BART station. It will add to the visual bulk of the BART station. Additional parking will also be necessary. Between Richmond and Pinole the alignment impact will be visual since the alternative is constructed on an elevated concrete viaduct similar to existing BART elevated sections approximately 17-20 feet high. It will not impact the coastal marsh. The Pinole station is at grade. It is not a large structure and will not be as obtrusive as the associated parking lot.

- From Pinole to the Carquinez Straits, the alignment follows the Southern Pacific and Santa Fe right-of-way requiring existing bridges to be reconstructed. New aerial structures over San Pablo and Franklin Canyon roads would be required to carry the line into the widened median of Interstate 80 to the Cummings Skyway Interchange. The widening of the median would occasion the necessity of a new stepped embankment in the cut sections of the highway right-of-way between Olem and Valina with adequate attention to erosion control required.

- Just south of the San Pablo interchange with I-80, the alignment leaves the I-80 median and rises on structure over the approach ramps and ascends to a new truss bridge over the Carquinez Straits west of the existing bridge. This new bridge can be

an independent structure or combined with a replacement for the aging westbound section of the Carquinez Bridge. New bridge construction would entail some impacts to water quality in the Straits during the construction process such as increased turbidity and sedimentation and the release of sediment-contained pollutants. All safety and mitigation measures provided by the Department of Fish and Game and others should be followed. Given the existing bridges, the visual impact would be negligible.

- Beyond the Carquinez Strait the alignment would enter the tunnel to Chestnut Street. Steps must be taken to insure surface stability and proper drainage as well as to control sedimentation and erosion during construction.

- Emerging at 5th Street, the alignment is on structure running along the right-of-way of the Southern Pacific Vallejo Branch. The elevated structure passes through residential neighborhoods and near commercial and light industrial activity. In the residential areas sporadically bordering the right-of-way between Georgia and Tennessee Streets the alignment would, in several cases, be no further than 50-75 feet from houses. The structure would constitute a substantial visual impact and the noise levels, though intermittant, would constitute a net increase over the present lightly trafficked situation. The elevated configuration would reduce the local traffic disruption but at the same time increase the severance of adjacent residential areas.

- Beyond Napa junction the alignment follows the Southern Pacific right-of-way and Highway 12 at grade through an elevated plain (Jamison Canyon) at the base of a steep sided valley edged with 500 to 1000 foot hills. Noise reverberation will be an intrusion in this otherwise rural setting.

- The alignment follows the Southern Pacific right-of-way crossing I-80 on a bridge. It then descends to grade and passes under Highway 21 after which it ascends to an aerial configuration to minimize impact on the upper Suisun Marsh. This alignment avoids both the Buffer Zone and Upland Protection Zone under consideration by the Department of Fish and Game. The Cordelia station is located in an area planned for warehouse and light industry. However, it is also the historic center of the town. If preservation becomes a significant local value, an alternative treatment to the alignment is possible.

- Between Cordelia station and Fairfield, the route follows the Southern Pacific right-of-way in a mixed aerial and grade construction across farmland to the elevated Fairfield station where the existing track crosses Rio Vista Road (Highway 12 near Union Street). This elevated station could offer a major impetus to development (see pages xx through xx). Relocation of existing storage facilities might be advisable although not necessary. The elevated structure will be visible largely to light industrial and warehouse areas, and some commercial areas.

- Beyond Fairfield the alignment follows Southern Pacific right-of-way through the hills north of Travis to flat agricultural land beyond Cannon through Elmira and Dixon to Davis. Drainage ways will be accommodated, and the structure is elevated to avoid crossing roads and irrigation canals. Occasional frontage roads are necessary. After crossing I-80, the line continues in an aerial configuration through Davis to a station at the existing Amtrak Depot. The elevated structure would introduce an element of visual intrusion into the existing older housing to the south of the tracks.

- Beyond Davis the line would follow the Southern Pacific tracks to the Sacramento River, crossing in a new truss bridge north of the existing I Street bridge. This bridge would have only a minor impact on the Old Town Historical Area character since it would be north of the existing bridge. However, if the new station is located east of the Highway, the aerial structure overpassing would be visible.

Improved Passenger Train/Highway Modification (Rail RN Hwy)

This alternative is identical to Rail RN/BART R alignment between Richmond and Cordelia. Beyond Cordelia, the alignment is at grade in the median of I-80 until Davis, requiring the widening of the median strip to 74 feet and the reconstruction of all interchanges and overpasses. The variation has been investigated to determine its capital cost advantages.

- At the Southern Pacific intersection with I-80 at Cordelia the alignment would enter the I-80 median and descend to grade. No major roadside commercial relocation would be required, although some access roads must be rebuilt. At West Texas Street, the alignment would leave the median and enter the

abandoned Sacramento Northern right-of-way in a retained cut through Fairfield. New bridges would be provided for all street crossings. The design of this cut would attempt to retain the linear park nature and trailway concept currently under development by the City of Fairfield. Landscaped fencing would be used to ensure safety. Relocation of one commercial property would be necessary. Transient noise levels would be reduced by the retained cut and the use of floating slab construction to reduce noise levels to approximately 70 dBA at 50 feet. The Fairfield station at Air Base Parkway would be below grade.

- From the station the alignment would be at grade on the Sacramento Northern right-of-way with over-crossings from local roads. New alignment in a long curved radius turning northwest would require some cut and fill south of Ulatis Creek with care taken to avoid erosion and sedimentation and provide proper retention.

- North of Mason Street, the line crosses the Sacramento Northern and regains the median of I-80 at grade which would be widened as necessary. The widening would require interchanges and overpasses to be rebuilt. Construction disruption of several commercial establishments would be incurred, and the widening would displace some parking and access roads.

- At the Route 113 interchange the line would descend into a retained cut under Davis Road to rejoin the Southern Pacific right-of-way in an aerial configuration. From this point east the alignment is identical to Rail RN.

<u>All Rail Alternatives--West Pittsburg/Sacramento (Rail PE, Rail PN, BART P)</u>

Between Fairfield and Sacramento these alternatives are identical to their corresponding alternatives from Richmond:

- Rail PE is identical to Rail RE
- Rail PN is identical to Rail RN
- BART P is identical to BART R

From West Pittsburg to Fairfield, Rail PE, Rail RN, and BARTP share a common route and alignment with the associated impacts as described below:

- At West Pittsburg an aerial station would provide an escalator transfer to the proposed West Pittsburg BART station. The line would be constructed on the abandoned Sacramento Northern railroad embankment and on structure through the marshes of Mallard Island, ascending to a tall truss bridge over the Suisun Bay channel. The route then follows the Sacramento Northern across Chipps and Van Sickle Islands on elevated structures descending to trestle through Clark Hollow. The elevated structure would represent an intrusion on the visual environment of the marsh.

- Structures rather than embanked fill will be employed to avoid altering the normal daily changes of tide level and water currents or the bottom characteristics of the channels in the marsh areas. In addition, construction measures must be taken to minimize sedimentation, erosion or turbidity as well as construction runoff pollution. The southern portions of this alignment are within the Department of Fish and Game's definition for a proposed protected Suisun marsh zone based on vegetative type. The physical presence of the new structure may effect the natural character of the area which makes it attractive to wild fowl and related recreation activities. The operation of trains over the structure would increase the intermittant noise occurrences and may disturb migrating wild fowl patterns.

- From Montezuma, the line continues to occupy the Sacramento Northern right-of-way at grade past the rolling Montezuma and Shilo Hills. Some new cut and fill will be required necessitating control of sedimentation and erosion. New road overpasses and the large stretches of track will conflict with the otherwise unspoiled natural character of the area.

- At Rio Vista junction the route leaves the Sacramento Northern right-of-way and turns northeast towards Travis Air Force Base. At Travis the line descends into a tunnel under the Northeastern runway to avoide interfering with the instrumented landing system. A new station would be established just beyond Travis property on open land serving the proposed Fourth Regional Jetport.

- From the station the line would continue in an aerial configuration over the Sacramento Northern and Cannon Road to join the Southern Pacific right-of-way, and continue north following the alignment of BART R and Rail R.

Tracked Levitated Vehicle--Oakland/Sacramento (TACV)

The TACV alignment, unlike the other technologies, is dictated in part by the required vertical and horizontal radii of curvature for 200 mph operation. The route is grade separated throughout for pedestrian and vehicular safety reasons.

- The TACV route from the Oakland terminal and Cypress and 7th is in a cut and cover tunnel to Emeryville and then elevated west of I-80 to Golden Gate Field in Albany. Temporary construction impacts would disrupt the affected neighborhoods. The major permanent impact along this route would be visual--an elevated structure between the mud flats and the highway.

- At Albany, the alignment would cross the mud flats and follow the Southern Pacific right-of-way on the west side through industrial areas and near some residential neighborhoods in Richmond and North Richmond. Its elevated configuration would introduce a major structure similar to BART (17-20 feet high) into these areas.

- At Sobrante, the route enters a tunnel leading to a ventilation structure at the southwest end of an 8 mile subacqueas tube under San Pablo Bay and the Carquinez Straits. The tunnel emerges at a ventilation structure at Semple Point. The impacts of tube construction would be similar to those associated with the BART Trans-Bay tube. These impacts, excessive turbidity and the release of contaminated bottom sediment, result from either the removal of consolidated and unconsolidated sediment to place tunnel sections in the shallow Bay and the disposal of excavated materials. Dredging and construction must be carried out using techniques and timing to minimize problems of materials entering suspension, increasing turbidity or B.O.D. Disposal must use acceptable dump sites.

- At Semple Point the alignment enters a deep bore tunnel under the Glen Cove hills and crosses the Benecia State Recreation Area marsh in an elevated configuration. Redesign may be possible to avoid this potential impact which severs the upper third of the marsh visually from Southhampton Bay.

- After crossing Highway 680, the route enters a second deep bore tunnel, 4-5 miles in length under Sulpher Springs Mountain, daylighting at Pierce. The line then continues in an aerial

configuration along the Southern Pacific right-of-way skirting the Suisun Marsh on the east side. Suisun Marsh is one of the state's largest wetlands and a major nursery for coastal and marine fishes. This, in addition to its importance has a habitat for wildlife and migrating non-game birds, suggests the impact of the presence of such a structure should be carefully reviewed. Structures must avoid interferring with the marsh tide and drainage patterns and construction techniques must not cause increased siltation or sedimentation. Such impacts would be substantially greater than the adverse impacts associated with the existing railroad. The effect of the simple presence of the structure and the impact of hourly 200-mph trains on the marsh fauna must be studied. Although there is already an operating railroad present, the conditions created by the Tracked Air Cusion Vehicle would adversely affect the tranquil wilderness character of the area with their accompanying noise and draft.

- The alignment would continue elevated to a station which would be located just north of Rio Vista Road (Highway 12). This station and the impact of the alternative north to Sacramento would be similar to the Rail RN or BART R alternative with two exceptions--first, the entire route is an aerial structure and the trains are at considerably higher speeds with noise impacts that are not fully known at this time; second, the alternative bypasses Davis to the south and terminates in an aerial park-ride station at the I-80/Sacramento tube interchange, thus avoiding the impacts of a downtown Sacramento terminal.

<u>Conventional Rail-Antioch/Stockton (Rail AE)</u>

This alternative would use the existing track(s) of the Atchison, Topeka and Santa Fe railroad from a proposed BART station in Antioch to a Stockton station. The Antioch station would be a cross-platform transfer near the river front.

- Between Antioch and Stockton the route would use 8 miles of existing Santa Fe double track but adding 21 miles of new single track immediately adjacent. This would require widening the existing embankment. This action could have erosion and sedimentation impacts on Delta sloughs and canals if not controlled during construction. A section of coast marsh would be bordered with possible construction impact. The alignment parallels the Mokelumne acquaduct and one section of marsh constituting wild fowl habitats between the Old and Middle Rivers is transected. The river's marshes are steelhead spawning grounds.

- The alignment is almost completely on flat uninhabited land. Major long-term impacts would be visual changes on the character of the area associated with train operations themselves.

- The station options depend on whether Stockton/ Sacramento service is also proposed. If not, the preferable station would be the existing Santa Fe depot. While highway access is not direct, the impacts of at-grade operations on local traffic are considerably less than with the use of the Southern Pacific station.

<u>Conventional Rail--Stockton/Sacramento (Rail AE)</u>

The route between Stockton and Sacramento follows the existing Southern Pacific track(s). Twenty-eight miles of new track would be required.

- The continuation of the Antioch-Stockton route to Sacramento requires running trains through downtown Stockton between the Santa Fe and Southern Pacific depots. A new connecting radius between Santa Fe and Southern Pacific tracks at Aurora and Sacramento Streets would be required. Grade-separations at Oak and Parker, Main and Market, Bianco and Alpline would cause construction disruption and disturb access to activities within the area of street depression.

- The route to Sacramento is through open land to Lodi. No potential impacts are apparent. At Lodi, the terminal would be between Elm and Pine Streets, three blocks from the Civic Center. The route through Lodi interfers with local traffic since low speed operations in and out of the station do not require grade separation from a safety point of view.

- Beyond Lodi, the alignment to Sacramento travels relatively flat open space crossing a number of small tributaries of several rivers, a marsh off Badger Creek and the Consumnes River. No major impacts are anticipated other than erosion and sedimentation dangers associated with widening the existing embankment.

- The alignment enters Sacramento passing the Sacramento Army Depot and Sacramento State University. Its impact in this area will be largely those caused by increasing train operations--visual and noise during train operations. In addition, no additional grade separations are currently planned since train frequencies are low and trains are short. Traffic disruption will increase over today but may be at an acceptable level.

ENERGY

The current energy crisis suggests that the intercity passenger transportation improvement alternatives should be examined from the point of view of their potential energy savings. While total use data awaits patronage forecasting and resultant vehicle mile calculations, a comparison among system types can be made on an efficiency basis.

Figure 29 indicates the range of energy used by the technologies under study at their average intercity speeds. Energy in this comparison is being expressed in BTU for normalizing convenience. For each technology, efficiency of propulsion energy use is assumed to be the 25-35 percent area. For the electrical energy-based systems, an energy conversion heat rate of 10,000 BTU/KWH is assumed. For gas powered vehicles, a conversion rate of 136,000 BTU/gallon is assumed.

It is evident that there are three district ranges of energy use: express bus, BART and rail cluster between 1,000 and 2,000 BTU/passenger mile. Automobiles and tracked air cushion vehicles are in the 3,000-5,000 BTU range, while the energy price of powered lift puts short-haul air systems in the 10,000-20,000 BTU/passenger mile range.

It should be noted that only propulsion (or traction energies are being compared. Maintenance and station energies are also important energy costs which vastly complicate any comparison since they vary greatly from system to system. Furthermore, construction energy should, theoretically, be included in any comparison. No such data yet exists for system comparisons since complex input-output analysis would be necessary.

To a degree, different services are being compared with different speeds, different levels of comfort and convenience, and different costs. The line-haul travel time savings are, roughly speaking, proportional to the energy expended. In addition, load factors are critical to the comparison as different assumptions can drastically change the comparison. A uniform 50 percent load factor has been assumed in this discussion.

Finally, the energy source for the power plant involved may vary from refined gasoline to the various electric energy sources--coal, oil, natural gas, uranium or hydroelectric--each with different degrees of availability, pricing and future stocks. Given the current fuel shortage a comparison of the potential petroleum savings associated with the improvement programs is instructive. In 1995 there may be as many as 300,000 intercity trips per day within the study area that are potentially divertible to a new transportation mode. This is the equivalent of 10,000,000 to 12,000,000 passenger-miles of travel.

FIGURE 29

ENERGY CONSUMPTION OF ALTERNATIVE TECHNOLOGIES

	BTU/Vehicle Mile	BTU/Passenger Mile with 50% load factor
Automobile (standard at 14 mpg)	8,000-10,000	4,000-5,000
Bus (scenicruiser at 5mpg)	28,000-30,000	1,100-1,300
BART (Healy Report)	35,000-50,000	1,000-1,400
Turbotrain (United Aircraft)	40,000-50,000	1,600-2,000
Conventional Diesel-Electric Train	70,000-80,000	1,700-2,000
TACV (200 mph VF LIM)	1000,000-150,000	3,000-5,000
STOL (DHC7)	280,000-320,000	11,000-13,000
VSTOL (as per Douglas Aircraft Rept.)	350,000-400,000	7,000-20,000

On the average, 250,000 gallons of gas would be used per day if such travel continues to be made predominately by automobile. Diverting 25 percent of this travel to buses would save almost 45,000 gallons of fuel per day. A 25 percent diversion to turbo-electric trains would save over 22,000 gallons. If 15 percent were diverted to rail and 10 percent to bus, the result would be about a 35,000 gallon a day savings on gas.

NOISE

Noise can be a key negative impact of some transportation improvements, particularly in highly urbanized contexts. Noise can effect the quality of life in the adjacent property, either reducing their attractiveness and value or requiring noise reduction devices.

No independent calculations of noise impacts have been made as part of this study--rather existing sources and data from analagous situations has been reviewed--particularly the Northeast Corridor Study, BART data, studies by the Federal Rail Administration and manufacturers' data.

Figure 30 below shows the estimated noise level for the technologies under study as evident at 50 feet when operating at near-average speed. Without considerably more specific data only ranges of noise level can be identified.

Figure 30

COMPARATIVE NOISE LEVELS

Alternative	dBA
Bus	85
Freeway Traffic with trucks	80-90
Diesel electric train on upgraded track	85-95
Turbotrain on welded rail at grade	80-90
Turbotrain on welded rail elevated	75-85
BART at-grade	70-80
BART elevated	75-85
TACV elevated	85-95

While there is considerable overlap, turbine-hydraulic trains and BART on welded rail are the quietest. Conventional rail equipment on existing track and TACV are the noisiest. Vehicles chosen as prototypes for noise levels were as close as data permitted.

The measure of noise chosen was dBA--the "A" frequency weighting of sound pressure reflecting the variable sensitivity of the ear to different frequencies. While more complex measures are available, comparable prototypical data is not. In judging the usefulness of such data, several key points must be kept in mind:

- Sensitivity of receptor or land use
- Level of noise
- Duration and frequency
- Time of day
- Background noise
- Previous experience in that locale

The noise levels of Figure 40 must be put in a comparative framework of other noises encountered in corridor communities. Normal freeway traffic with trucks reach 80-90 dBA at 50 feet. Even normal traffic background noise on a busy arterial with some trucks and buses is 75-80 dBA at the typical residential setback line. Some of the transit alternative noise levels expected are not excessive on a comparable basis. Nonetheless, U.S. DOT standards suggest 70-75 dBA is desirable. These standards are shown in Figure 31.

Noise control programs are underway at the federal level to control noise both at the source and through shielding techniques. For example, the continuous welded rail and the lightweight trucks with minimum unsprung weight assumed for the turbotrain and BART alternatives tend to reduce their noise levels. Design specifications limiting propulsion system noise are also critical. Concrete (rather than steel) construction of aerial structures or retained cuts in lieu of surface (or aerials) structures also reduces noise propogation. Relatively simple sound-barriers (low walls at least 1.5 lb/sq. ft.) shielding direct line-of-sight exposure to the underside of the transit vehicle can achieve significant noise reductions. Figure 32 shows the wayside noise levels of a system (BART or turbotrain) passing at 70 mph at various distances with and without such a sound barrier.

The noise factor contributed to the decision to use existing highway and rail rights-of-way for routing the new alternative. The land-uses adjacent

FIGURE 31

DESIGN NOISE LEVEL/LAND USE RELATIONSHIPS*

Land Use Category	Design Noise Level - L_{10}	Description of Land Use Category
A	60 dBA (Exterior)	Tracts of lands in which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parks, or open spaces which are dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B	70 dBA (Exterior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, picnic areas, recreation areas, playgrounds, active sports areas, and parks.
C	75 dBA (Exterior)	Developed lands, properties or activities not in categories A and B above.
D	--	For requirements on undeveloped lands see paragraphs 5.a (5) and (6) of PPM 90-2.
E	55 dBA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

* Source: U.S. Department of Transportation PPM 90-2.

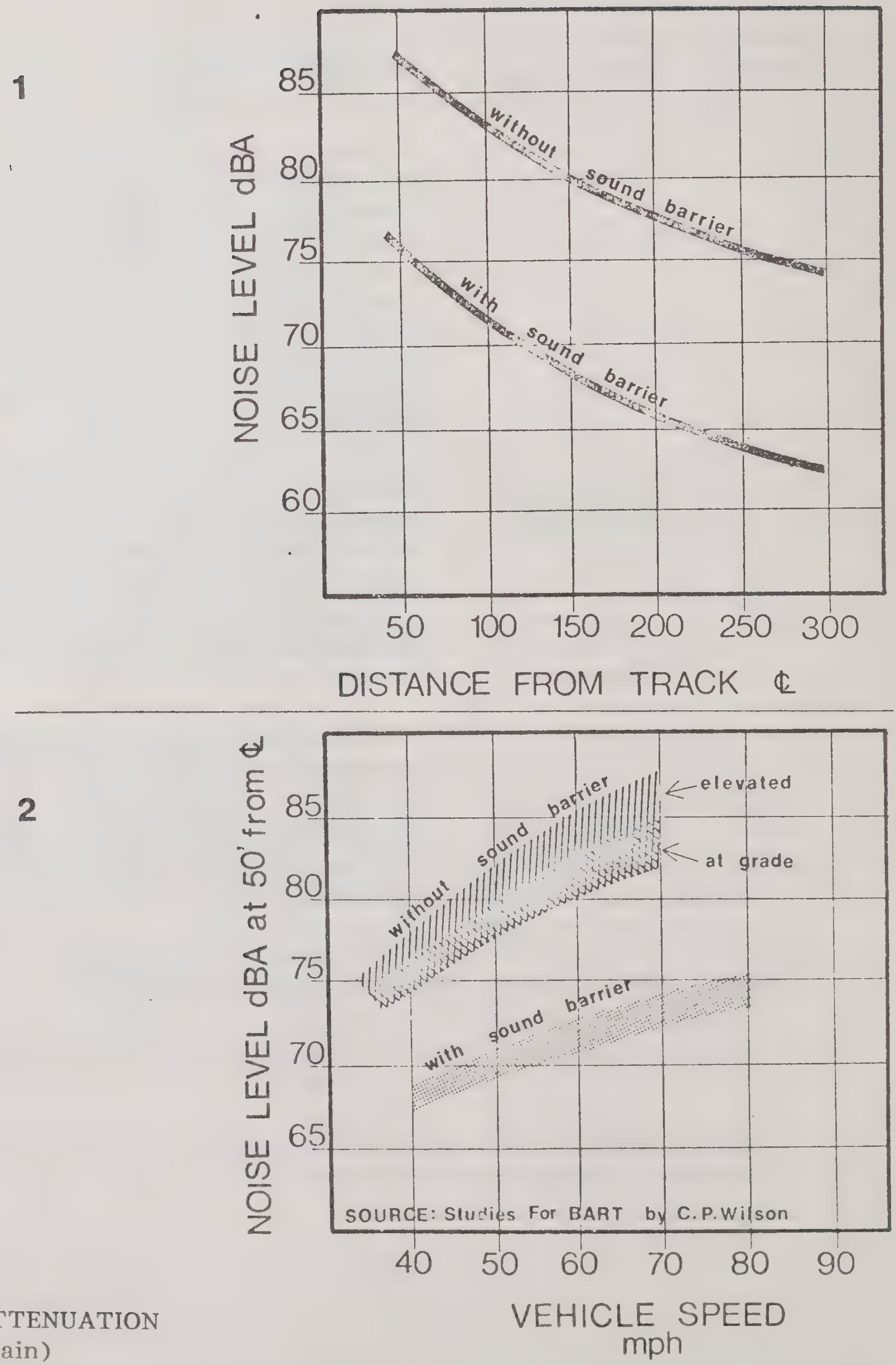

Figure 32
EXAMPLE NOISE ATTENUATION
(BART or Turbotrain)

to existing transportation alignments have, over time, adjusted to the level of disturbance offered by the transportation system operating within the corridor. Less sensitive uses, such as U.S. DOT Categories C and D, are located along most of these rights-of-way. In addition, noise-sensitive uses in these corridors have tended to locate at some distance from the rights-of-way.

The additional noise introduced by the new alternatives in most cases will extend the period of time per day when a high level of noise is experienced but for the most part will not represent an increased peak. Those alternatives using the existing Southern Pacific rights-of-way, for example, may double the number of trains passing a given point per day. The added trains will be short high speed and light weight in contrast to the heavier, slower, poorly suspended freights currently operating. The bus alternative will have relatively little added impact despite its own loudness since it is submerged in a relatively high and continuous freeway noise level.

In Vallejo and Fairfield, where the rail alternatives pass through the most built up environment encountered among the alignments, the vehicles will be moving at slower speeds since they will be entering or leaving stations. This will tend to keep the noise level down somewhat. With the sound barrier referred to above, the sound level can be brought down 10 dBA representing a 50 percent sound level reduction. A difference between 80 and 50 mph represents another 5 dBA reduction. While no detailed studies have been made, it appears that this combination can bring the quieter of the technologies close to the DOT standards in all but the few instances where development is less than 100 feet from the right-of-way. Further development in noise control is currently in the process of reducing the levels for the more advanced technologies.

REGIONAL ECONOMIC FRAMEWORK

Phase I carried out a detailed review of study area economic and demographic conditions to form the "setting" for the study--a description of future activities which would require transportation service and, in turn, be affected by it.

There are sharp differences among the various forecasts of how population will locate itself within the region between today and 1995. The number of persons by age within each county is now known, and the natural increase can be calculated by the cohort component method. There is general agreement on the results of this calculation. Assumptions about migration among counties, however, vary because of the large number of factors involved. Population growth within a county or district (which is our sub-unit within a county) may be limited by the amount of available and usable land. ABAG, for example, assumed that many of the older areas around San Francisco Bay would be limited by this availability of land. In addition, population location will be influenced by employment opportunity.

Major employers such as industries, military installations, educational facilities, and new towns will locate within the region, but could be attracted to one county or another because of the availability and cost of land, housing and amenities for employers, tax rates, the location of resources or labor force, and a variety of other factors. To a large extent the newer industries of the corridor region concentrating in new technology are footloose and can locate virtually wherever they desire. For this reason relative accessibility will be an influential factor.

Regional forecasts have assumed that the same relative accessibility relationship would exist among counties in 1995 as in 1970. However, rising energy costs of transportation may place a restraint on certain industrial locators--particularly those dependent on truck travel. In addition, fuel prices may act as a curb on the degree of suburban dispersion associated with residential growth. It is too soon to predict with accuracy the degree to which technology can adapt to offset tight energy supplies and higher energy prices. The major expected development activity in the key corridor where improvement alternatives locate are shown in Figure 33.

The economic development, the creation of housing and the resulting population may be encouraged or limited within various counties and districts because of the attitude of present residents. Throughout the corridor region, especially in urbanizing communities around the Bay, there is a new recognition of the environmental impacts of development and concern for limiting these

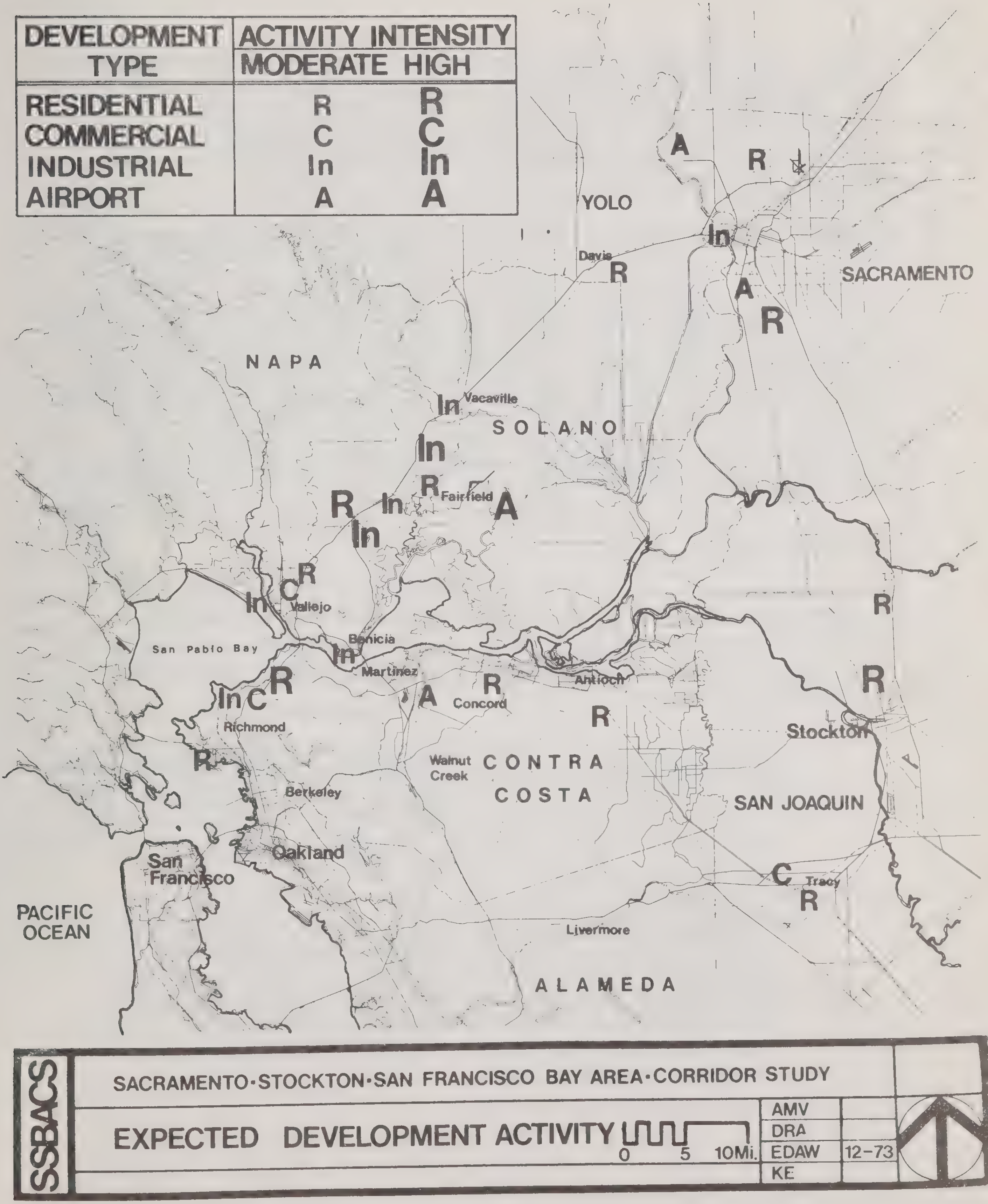
DEVELOPMENT TYPE
ACTIVITY INTENSITY
MODERATE HIGH
RESIDENTIAL R R
COMMERCIAL C C
INDUSTRIAL In In
AIRPORT A A
YOLO
Davis
SACRAMENTO
NAPA
Vacaville
SOLANO
Fairfield
Vallejo
San Pablo Bay
Benicia
Martinez
Antioch
Concord
Richmond
Walnut Creek
CONTRA COSTA
Stockton
Berkeley
SAN JOAQUIN
Oakland
San Francisco
Tracy
PACIFIC OCEAN
Livermore
ALAMEDA
SSBACS
SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY
EXPECTED DEVELOPMENT ACTIVITY
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Figure 33

impacts. There has been a call for the improvement of the "quality of life" even at the expense of the economic growth. Regionally, these concerns have manifested themselves in the support of a rather strong councils of governments in the creation of the conservation and development commissions, in strong regional bodies concerned with air pollution, water quality, open space, and growth limitation.

Because of the factors listed above there is considerable uncertainty about the future geographical distribution of population and economic activities. To a lesser extent there is also uncertainty about the total level of these activities at some future point in time. These uncertainties, created by limitations in forecasting techniques but more importantly by changing societal values and public policies have been incorporated into the study process--through the development of a series of Alternative Futures which describe a reasonable range of possible small area population and employment projections. These alternative projections are used to forecast patronage and to evaluate the transport and land development implications of the alternative transportation improvement programs.

<u>Alternative Futures</u>

Phase I developed the concept of Alternative Futures. From the range of possible factors influencing future socioeconomic patterns, key variables were chosen and placed into three combinations which appear to bracket the reasonable range of possible future development patterns. The three key variables are:

- <u>Moderate population growth versus low population growth</u> -- the moderate growth rate is that determined by using Series D of the states projections, while the low rate is close to Series E and slightly below the ABAG "low" projection for the nine county Bay Area and between the Series D and E projections for Sacramento and Stockton areas.

- <u>Continued southern growth versus a northern tilt within the Bay Area</u> -- the trend of growth is centered around San Jose at the present time; policy actions based on environmental capacity constraint may place more pressure on the northern portions of the Bay Area, principally in Napa, Sonoma and Solano Counties. ABAG has made projections for both possibilities within the concept of a moderate growth rate.

- Cities-centered versus dispersed--In contrast to the present trend of new development going into low density subdivisions on previously agricultural or rural lands, policy actions may be taken by existing cities to revitalize themselves and avoid "leap-frogging" and provide for a higher density within already urbanized areas. The California Statewide Transportation Study uses a city-centered concept, while the ABAG guidelines assume continued dispersal.

From all the possible combinations of these three factors, three "reasonable extremes" have been chosen for later sensitivity testing. These tests are designed to demonstrate the different impacts on the region, counties, and districts of forecasts at each extreme and a forecase more likely to follow present trends. The alternative futures have these characteristics:

Alternative Future One: Grow South/Low/Dispersed- The low-dispersed Future One is essentially a continuation of present trends and implies little change in the way of policy actions. Its likelihood will depend in large degree on the future course of the birth rate and state immigration.

- Assumes a low growth rate.
- Development would continue to concentrate in the southern portion of the Bay Area.
- New growth will be dispersed at a low density into currently open or agricultural land.

Alternative Future Two: Grow North/Moderate/Dispersed- A moderate dispersed future reflects a possible increase in the birth and in migration and Bay Area regional policy changes to shift the emphasis of new development.

- Assumes a moderate growth rate.
- A new emphasis would be placed on development in the northern portion of the Bay Area (even though the majority of growth would still be southern).
- New growth will be dispersed at a low density consistent with current trends and only a moderate level of environmental or developmental controls.

Alternative Future Three: Growth North/Moderate/City-Centered-The moderate city-centered future reflects a possible extensive regional effort to create and enforce strong development controls and to preserve open space and environmentally sensitive areas.

- Assumes a moderate growth rate.
- A new emphasis would be placed on development in the northern portion of the Bay Area (both of these points similar to Future Two).
- New growth will be city-centered, in all three areas of the region, occuring by infilling or as an orderly extension of existing development.

Since Alternative Futures One and Three represent the extremes of aggregate socioeconomic activity contrasts in location patterns and differences among the areas most likely to be affected, they were chosen for forecasting purposes. Special attention was given to refining Alternative Future Three (Growth North/ Moderate/City-Centered) since it represented a future condition most conducive to transit use as well as most responsive to transit in terms of development pattern impacts.

Zonal Socioeconomic Projections

The Alternative Futures provide a systematic testing framework for studying the relationship of alternative development patterns on transit demand. In addition, they provide comparative contexts for building in different transportation assumptions in development patterns. The Alternative Futures are used as a basis for travel forecasting, providing demographic inputs to travel demand. In the sections below, they provide a "snapshot" of future development alternatives against which economic and environmental impacts can be judged.

The economic activity and demographic projections for 1995 from Phase I (shown in Figure 34) were refined to the level of 125 zones based on modified projections from the three regional planning agencies. These modifications included a revision of holding capacities and areas offering "minimum constraints to development" for each of the three futures. Environmental factors from a wide variety of sources have been compiled and presented--selecting those which both influence development patterns and which represent areas sensitive to the direct and indirect impacts of transportation improvements. Major environmental concerns from which these modifications were made are shown on Figures 35 and 36.

FIGURE 34

COMPARISON OF ALTERNATIVE FUTURES FORECASTS
TO CALIFORNIA STATEWIDE TRANSPORTATION STUDY--1995

	1970	1995			1970	1995		
	July 1970 Baseline[1]	Population Forecast Alternative Futures #1	#2	#3	July 1970 Baseline[1]	Employment Forecast Alternative Futures #1	#2	#3
CORRIDOR REGION	5,728.3	7,925.1	8,680.3	8,680.2	2,350.2	3,231.5	3,617.4	3,684.2
San Francisco Bay	4,645.3	6,393.0	7,058.1	7,058.1	1,927.3	2,607.7	2,957.9	3,000.5
Sacramento Area	792.3	1,132.1	1,203.6	1,203.6	307.4	472.6	502.5	502.5
Stockton Area	290.7	400.0	418.6	418.6	115.5	151.2	157.0	181.2
Counties								
Alameda	1,076.1	1,393.0	1,401.2	1,451.0	457.4	679.6	726.9	773.9
Contra Costa	558.1	891.4	937.4	923.8	137.2	204.1	309.1	310.0
Marin	207.5	287.8	351.4	320.0	50.7	64.5	98.4	79.0
Napa	79.7	145.7	227.4	170.7	25.8	32.2	52.7	36.4
Placer*	62.6	97.2	110.1	93.7	18.0	33.7	(38.2)	37.2
Sacramento	637.5	877.0	919.0	944.7	256.3	374.5	373.0	397.9
San Francisco	714.3	722.3	723.4	777.0	1,198.5	544.6	561.5	573.0
San Joaquin	290.7	400.0	418.6	418.6	115.5	151.2	157.0	181.2
San Mateo	556.7	746.9	700.7	776.0	216.3	291.7	268.1	306.2
Santa Clara	1,074.1	1,576.4	1,579.9	1,576.7	428.7	652.8	669.3	674.1
Solano	173.6	285.0	479.4	460.2	54.1	62.1	134.5	119.7
Sonoma	205.2	344.5	657.3	652.7	58.7	76.1	137.4	128.2
Yolo	92.2	157.9	174.5	165.0	33.1	64.4	71.3	67.4

[1] 1970 Baseline numbers are for July 1, as used in the California Statewide Transportation Study, based on estimates of the Department of Finance, Population Research Unit.

*Roseville District Only

CBD	Urban areas and military facilities		Ground slope greater than 20% source: 3	Sources: 1 USGS topographic map, scale 1: 250,000 2 USGS/HUD, S.F. Bay Region Environment and Resources Planning Study a Basic data contribution 15, 16, 17, 18, 19, 20 b Basic data contribution 11 c Basic data contribution 8 3 USGS slope map, scale 1: 125,000 S.F. Bay Region 4 "A Conservation Element for the Sacramento General Plan," Sacramento City Planning Dept., June 1973 5 "Conservation Element," San Joaquin County Council of Governments 6 Mapping by Mr. Perry Wood, USGS Water Resources Division, Dec., 1973 7 Preliminary Regional Plan, Conservation Element, Sacramento Regional Area Planning Commission, Aug., 1969 8 ABAG, "Land Capability Map," July 1967
	Park and Game/Wildlife Preserves source: 1		Unstable Areas — High Landslide and Subsidence Potential Source: 2b, 4, 5	
	Marsh lands or salt evaporators source: 1		Fault zones source: 2c	
	Flood plains source: 2a, 4, 5		Probable aquifer recharge areas source:4, 5, 6	
	Zones in Which Some Areas May Flood		Prime agricultural soils source: 5, 7, 8	

SSBACS

SACRAMENTO ▪ STOCKTON ▪ SAN FRANCISCO BAY AREA ▪ CORRIDOR STUDY

DEVELOPMENT INFLUENCES

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Figure 35

Woods and brushland source: 1

Low mountains and hilly areas source: 2

Range of one or more endangered or rare wildlife species source: 3a

Critical salmon and steelhead spawning and nursery habitat source: 3b

Important marshland habitat for water fowl and water associated wildlife source: 3b

Sources:
1 USGS topographic map, scale 1: 250,000
2 USGS slope map, scale 1: 125,000
3 "Environmental Goals and Policies" State of California Office of Planning and Research
a Map 6, Endangered and rare fish and wildlife
b Map 14, Fish and Wildlife. Selected critical habitat and protected areas

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	WILDLIFE HABITAT	0 5 10Mi.	AMV / DRA / EDAW / KE — 12-73

Figure 36

In addition to interpreting and mapping constraints, regional plans were reviewed for policies affecting future development. Common goals and policies regarding relationships between urban growth and environmental protection and enhancement advocated by the regional planning agencies were incorporated into a zone-by-zone review of existing future projections. Where conflicts with these policies appeared to exist, zonal projections were modified, holding regional totals constant. Major environmental criteria employed were:

- Public Safety and Welfare--In order to avoid areas of direct hazard to life and property, development should be restricted from such areas as flood plains, landslide and fault zones, and areas of steep slope and unstable soils.

- Enhancement of Recreation Potentials--Proper development of this valuable resource should be accomplished through establishment of policies supporting programs and long range acquisition of parks and recreation lands, reserving parklands in urban areas to act as buffer zones, and preserving lands of outstanding recreational potential.

- Protection of Natural Resources--Lands producing an economically viable natural product should not be urbanized. Of particular concern are prime agricultural soils areas which include soils of a "Land Capability Classification" Class I and II, and a "Story Index" of 80-100. In addition, aquifer recharge zones should not be developed to help assure the future of water supply from natural underground reservoirs.

- Wildlife Protection--Conservation of hill areas to avoid loss of habitat and siltation of streams and water bodies and other degrading aspects of surface water quality. This includes conservation of unique or unusual features such as the Delta Region as an important wildlife habitat and fish spawning areas.

- Open Space Relationships to Urban Form--Concentration of urban growth around existing community centers should be encouraged. Skipped-over lands in urban areas should be developed to economize use of existing investments in public facilities. Region-wide green space system desired for separation between developed areas should be accomplished in leaving agriculture in an unimproved state. Planning and managing lands should serve a multiplicity of open space purposes, i.e., utilization of drainage floodways as linear parks and pedestrian linkages. Open space should be protected to establish the shape

of urban growth in order to reinforce community identity; emphasize distinctive centers which act as activity focal points; and to improve community's character, sense of being and natural setting to the highest possible aesthetic quality.

The environmental constraint and policies information was combined with economic activity projections to modify the alternative futures--population and employment distributions--which are used as the numerical framework for travel forecasting. Two significant aggregate changes were made:

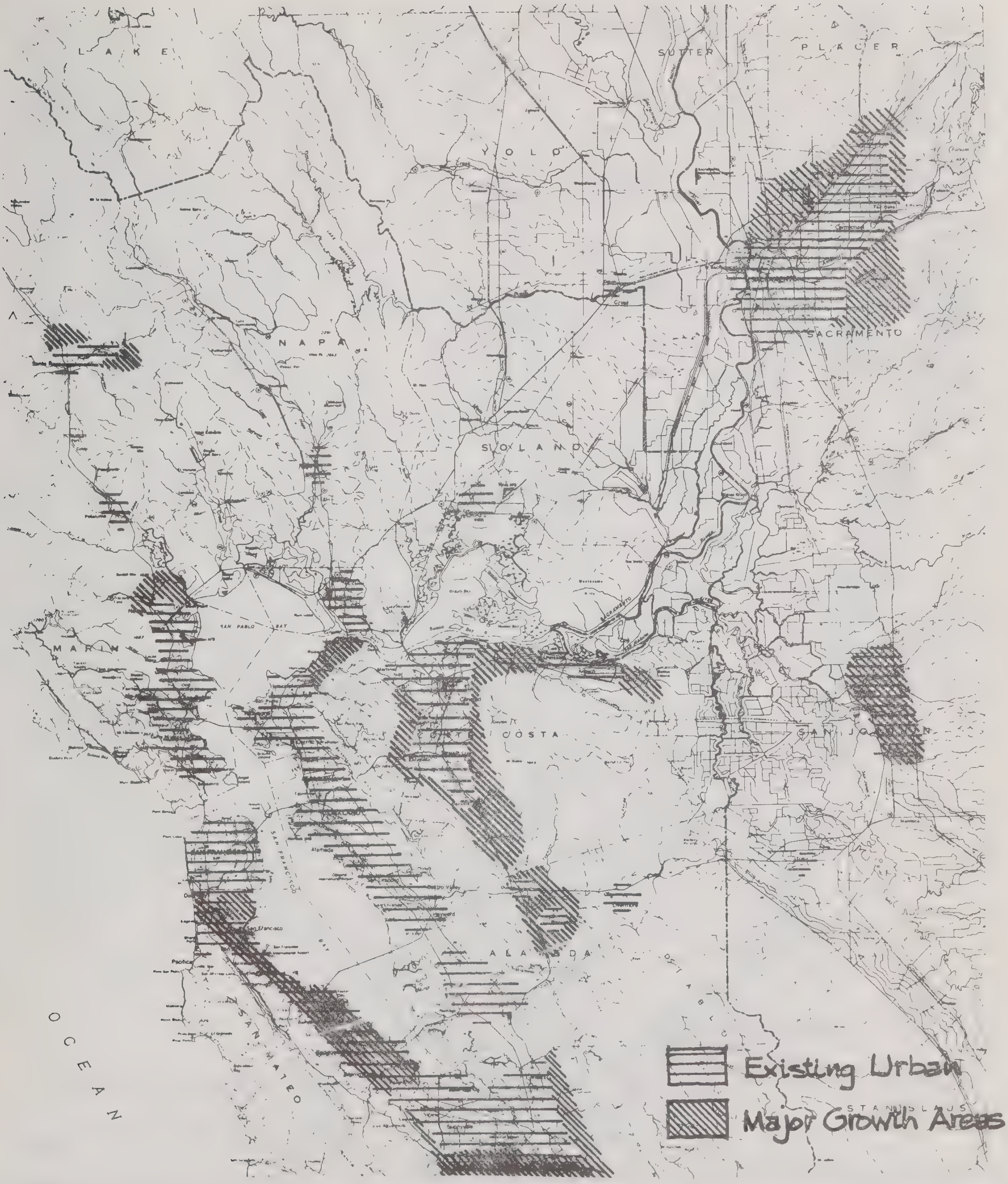
- Revision of Alternative Future One (Grow South/ Low/Dispersed) to represent a position closer to the State Finance Department's E-O Alternative in terms of birth and migration range and "no-growth" environmental restrictions.

- Revision of Alternative Future Three (Growth North/ Moderate/City-Centered) in terms of current development plans and environmental constraints.

Diagrams of the existing and projected major growth areas in the Study Region are shown as Figures 37-39.

Figure 40 summarizes the major economic and policy assumptions underlying the different distributions of population and economic activity associated with each of the alternative futures. This distribution of population and economic activities in the region hypothesized by each alternative future provides the background for a descriptive judgment of the impact of each intercity passenger transportation improvement alternative. Since none of the regional projections used as a base assumed any such system, new systems would represent a net improvement in accessibility over that employed in the original 1995 projections. All the improvement programs in common provide increased transit accessibility in the northern counties. This tends to support the assumptions underlying the two "growth north" alternatives (Two and Three). The fact that this accessibility is provided at specific nodes (stations) only, tends to reinforce the concentration rather than the dispersion of northern growth and responds to the implied environmental and urban revtalization scenarios assumed. The location of the nodes of improved accessibility in existing downtowns further reinforces the Alternative Future Three scenario.

Zonal projections of the amount and distribution of accessibility sensitive activities included a wide variety of demographic and economic parameters needed to determine the reasonableness of forecasts as well as required for travel forecasting itself. While ABAG, MTC, SRAPC and SJCCOG zonal



SSBACS	SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY		
	ALTERNATIVE FUTURE 1 low growth dispersed	0 5 10 15 20 25mi	AMV DRA EDAW KE

Figure 37

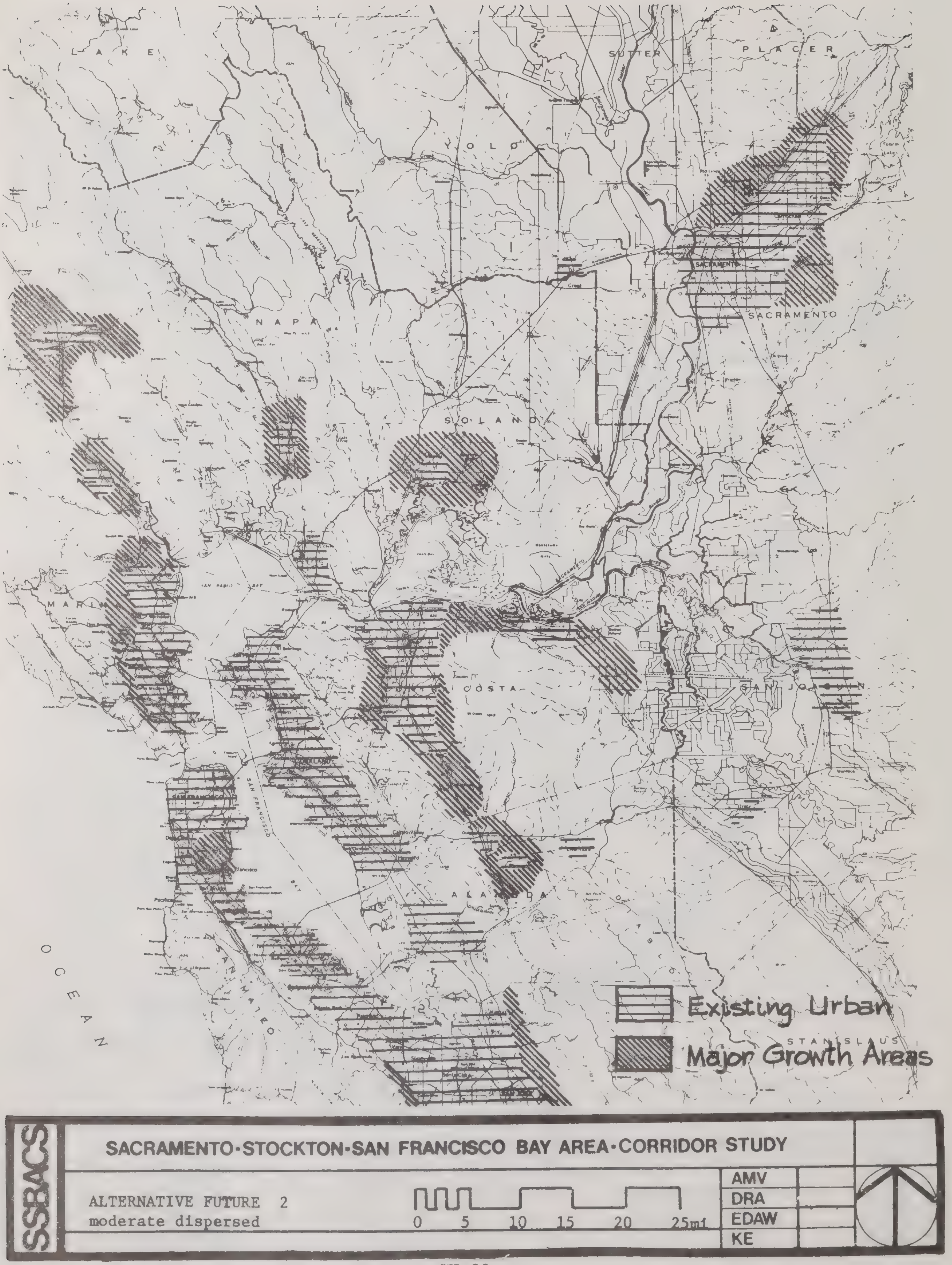

LAKE
SUTTER
PLACER
YOLO
SACRAMENTO
NAPA
SOLANO
MARIN
COSTA
SAN JOAQUIN
ALAMEDA
SAN MATEO
OCEAN
STANISLAUS
Existing Urban
Major Growth Areas
SSBACS
SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY
ALTERNATIVE FUTURE 2
moderate dispersed
0 5 10 15 20 25mi
AMV
DRA
EDAW
KE

Figure 38

SSBACS

SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

ALTERNATIVE FUTURE 3.
Moderate City Centered (revised)

0 5 10 Mi.

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Figure 39

FIGURE 40

ASSUMPTIONS FOR ALTERNATIVE FUTURES

Regional	Alternative Futures I	Alternative Futures II	Alternative Futures III
Birth Rate	2.3	2.45	2.45
Net In migration to State	100,000	150,000	150,000
Overall Environmental Limits	No environmental constraints		Strong environmental constraints
Aggregate Location Trend	Continued emphasis on southern portion of Bay Area	New emphasis on northern counties to relieve pressure on southern Bay Area	
Redevelopment of Existing Urban Centers	Continued low level of effort		Renewed effort to revitalize existing centers--Extensive in-filling of recent suburban growth
Densities of Urban Growth:			
Urban	Moderate density infill 10-12 DU/acre	Moderate density infill 10-12 DU/acre	High density infill 15-20 DU/acre
Suburban	Low density (as prevailing) infill (4-5 DU/acre)	Low density suburban infill (5-6 DU/acre) and low density expansion 4-5 DU/acre	Moderate density suburban infill (6-8 DU/acre) Some suburban expansion at 4-5 DU/acre
Land Utilization	Limited to developable land Preserve some open space	Develop some marginal land and convert agriculture, little space preservation	Preserve large amounts of open space and agriculture, use by passed parcels
Accessibility	Continued reliance on automobile with moderate road construction	Continued reliance on automobile with some road construction, primarily to northern counties	Less emphasis on auto with few roads; more reliance on transit
Local constraints on Growth and Development	Some pressure taken off because of lowered demand but efforts to prevent dispersal will occur in selected areas where sufficient non-constraint is available	More intensive efforts to constraint development but these will be overridden for much of the region	Most extensive constraints on new development will result in renewed emphasis on city centers but overall region will be allowed to grow
Level of Development Controls			
- Sewer Connection Policy	Not always required in new areas		Mandatory connection
- Trunk live extension	Extended upon request		Extended only within unorganized area
- Open space dedication	Not required	May be required in some area	Required throughout region
- Zoning controls	Present trends	Some density restrictions	Emphasis on planned unit devel.
- Enforcement levels	No special effort	Some correction shown	Extensive enforcement of laws
- Method of achieving goal	Present trends continue in planning and zoning but: - Expand programs for family planning - Initiate manpower programs to employ locally unemployed rather than hiring workers from outside the region - Discourage present programs of industrial and economic development	North Tilt emphasis assumes: - ABAG adopting Northern Tilt Policy - Use of ABAG general planning A-95 Review Authority to prevent portion of new growth in the south - State provision of highways in northern Bay Area (not in southern) - Improved rapid access from north to San Francisco, Sacramento and Stockton - Consideration of imposed development limits in regions suffering from air and water pollution	City Centered emphasis assumes: - Establishment of urban expansion areas based on general plans of cities counties and regional councils - Policy to annex territory and provide utilities only within urban expansion areas - Amend tax laws to discourage urban assessment of nonurban land, thus resulting in conversion - Amend revenue system to allow all jurisdictions to share in economic growth of region - Major public transit service between Bay Area and Sacramento - State restriction of development on environmentally sensitive land State and regional programs to acquire or preserve open space and prime agricultural land Plan and provide transportation only to city centered areas
Highway Congestion	Slow rate of increase in urban areas in north	Moderate rate of increase in urban areas in north	Moderate rate of increase but localized in urban areas in north

data was used as far as possible, important modifications were made. These modifications were of two types: "technical" and "policy." "Technical" modifications were made to overcome base or future year data inconsistencies. These included:

- Lack of common base year parameters. This required development of new and consistent 1970 base parameters common to all areas.
- Lack of common parameter definition. This required considerable parameter modification.
- Errors, internal inconsistencies and lack of logic in parameter relationships. These were jointly detected and eliminated working closely with agency staffs.

"Policy" modifications made to the zonal projections were of two types--changes in response to environmentally based development constraints and changes in response to known economic activity potential or limitations.

Historical and current information about the three major regions were reviewed by the team to establish a current regional context for the projections. The information reviewed included the following:

- Regional and county total socioeconomic statistics.
- The characteristics of existing and planned regional infrastructure systems including transportation systems, sewer systems, and water systems.
- Existing land use and major developments planned for the near term future.
- The locations and characteristics of the region's major activity centers, including office space concentrations, heavy industrial concentrations, light industrial concentrations, major academic and R&D employment concentrations, major government facilities, major parks and recreational facilities, major retail shopping districts and shopping centers.
- The locations and characteristics of major residential areas.
- Environmental and physiographical characteristics such as surface water, slopes, unstable soils, major earthquake faults, flood plains, land in agricultural use, wooded and heavily vegetated areas, and areas with unusual air quality problems.

Following a sequence of zones from the largest and most urbanized areas to the fringe areas, zonal population projections were reviewed and modified followed by employment projections. Regional totals were maintained,

followed by employment projections. Regional totals were maintained, and county totals were respected where possible. Particular attention was given to bringing out significant socioeconomic, physical, and environmental opportunities and constraints for each subregion, and how public and private residential land developers and business enterprises would view each zone in making their locational decisions within the regional context.[1/]

REGIONAL IMPACTS

Given the intercity nature of the transportation improvements under consideration, it is reasonable to expect that economic impacts will occur through changes in the structure or level of interregional activities. The impact of accessibility improvements on a series of selected categories of socioeconomic units in the region, such as residential activity, the production and distribution of goods and services, the consumption of goods and services, and use of the regional transportation system has been analyzed.

Several key qualifications underlying the following discussion of regional impacts:

- Changes in regional accessiblity achieved by most alternatives will be marginal changes since in order to minimize negative impacts and provide maximum service most transit alternatives have been located in the historical transportation/urban development corridors where good highway access already exists. Its impact will depend on how it affects a cluster of related factors including the local economy, land prices, taxes, labor supply markets, etc.

- Full capitalization on the potential benefits of intercity transit will depend on coordinated public planning. Complimentary urban development or urban renewal strategies may make it possible to capture the unearned external spin-offs from the transport investment.

- The strength and pattern of accessibility change influence will vary with each transportation improvement alternative. The strength depends on the level of service offered by the alternative as measured by travel time reductions over the automobile automobile among key trip origins and destinations and the

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[1/] See Technical Memos General Approach to Socioeconomic Projections, Approach to Zonal Forecasts.

degree to which such service generates a transit market. Travel forecasting will provide a more precise measure of this fact.

- The pattern of accessibility change influence will depend on station locations and the manner in which they establish accessibility advantages for particular locations. Accessibility advantages of transit as translated into land value changes tend to be concentrated around stations and terminals, particularly where local feeder/distribution systems are not strong.

- The impact of each intercity alternative will vary depending on the costs and level of service of automobile operation. The greatest impact would occur if one of the higher speed systems were implemented while automobile energy-related operating costs rose and highway speeds remained at 55 mph. Significantly smaller impacts will occur if automobile and intercity transit costs and travel times are comparable.

- The economic impact of intercity transit is not as intense as commuter-oriented urban rapid transit--as measured by the number of people using the facility from any given station in a given time period. It will not provide the major impetus for the type and magnitude of suburban residential growth associated with BART lines. While intercity facilities would be used for commuting by some, a large segment of users will be business trips, and social or recreation-oriented travel.

- The fact that the intercity transportation improvement alternatives are located in existing transportation corridors serving existing cities makes their impacts-both activity generating and activity transferring--more difficult to predict. These areas already have accessibility by automobile and are the focus of highway transportation so that the addition of transit is as much a qualitative change in access as it is quantitative.

The region's socioeconomic units have been grouped into categories on the basis of the interaction between the units and the regional transportation system. The three major classes into which the socioeconomic unit categories have been organized are:

- Transportation system users
- Existing land uses
- Future activity locators

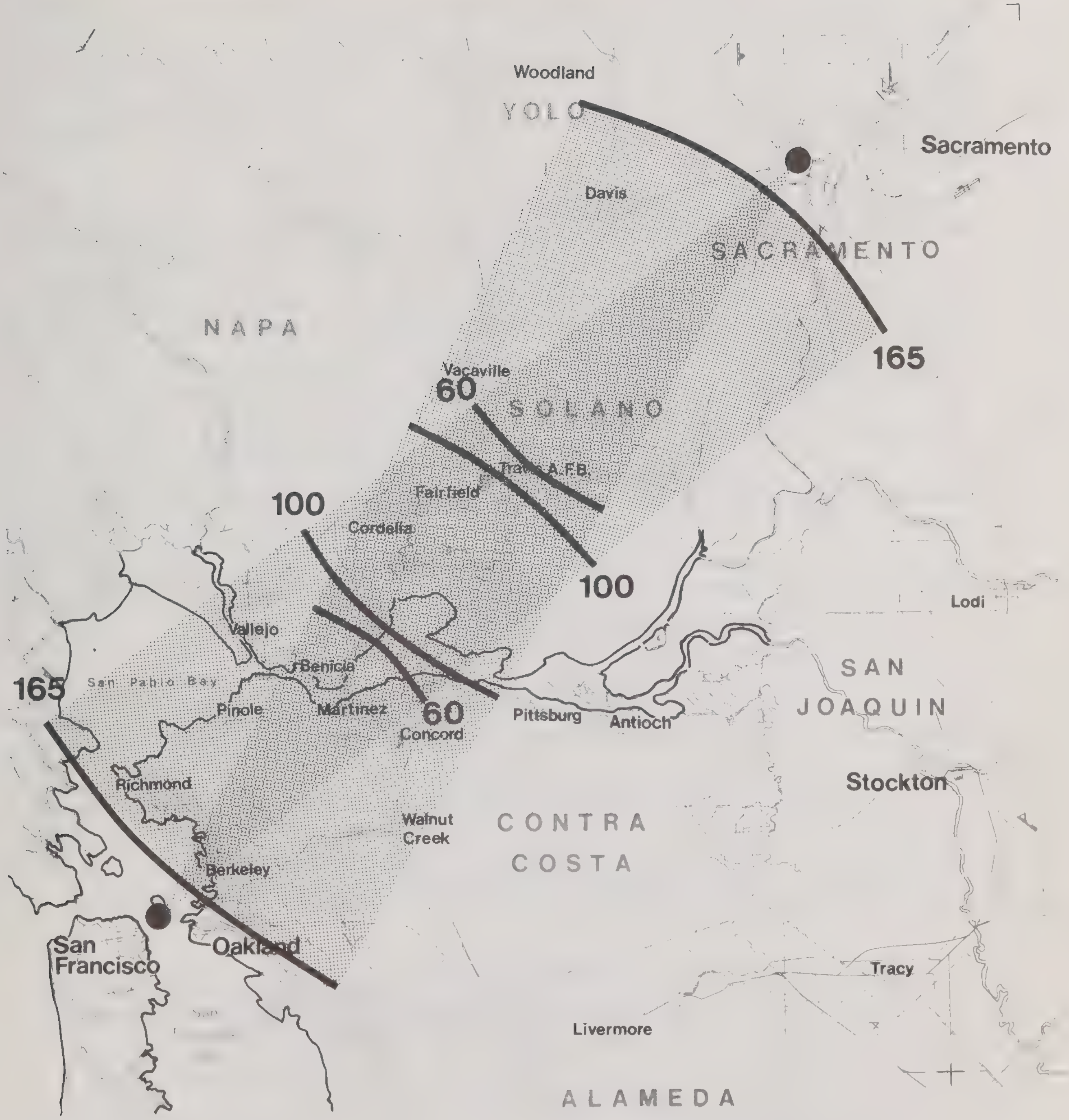
The primary effect that improvements in the regional transportation system will have on socioeconomic units is to improve the accessibility of socioeconomic units to other socioeconomic units located at other places throughout the region. "Accessibility" in this context means the time, cost and convenience of moving people and goods from one location to another about the region.

Regional Structure Changes

Regional impacts occur if the new systems permit economies of scale or a qualitative change in the relationships among the socioeconomic units of society. Past decisions by economic locators and the resultant pattern of socioeconomic activity which has developed in the region were formed by the transportation system with a given level of access at that time. In the study region, this system, while originally rail and water oriented, is now based on goods and people movement by highways averaging 60 mph on freeways between urban areas. Commute trips to work are largely limited to 30 miles (45 minutes) or less. For example, less than 10 percent of Fairfield/Suisun resident workers commute to San Francisco, the Bay Area or Sacramento.

With a doubling of speed travel, distances covered within an acceptable commute time would double. Figure 41 illustrates this for travel between San Francisco and Sacramento, each band shows a half-hour trip at the indicated speed. This type of impact would be "structural". Through shorter travel times, intercity trips would be made that otherwise would be impractical. Economic locations would have access to a greater labor market. Commuters would have more freedom of residentail location and in particular could take advantage of cheaper land further from the major urban centers. Urban areas could become more specialized since they would effectively be "closer" together. This type of change would affect government and public facilities, economic units that produce goods and services, residential land users and several special groups.

Government and Public Services--The location of the seat of government in Sacramento is a result of the historical circumstances of mid-nineteenth century of California history. The city is relatively isolated from the bulk of Northern California population--to say nothing of Southern California. California's financial center and seat of government are separated by an hour and a half drive, a fact which could be substantially modified by the installation of a new intercity transit system. Recently, communication problems and economic pressures have led to actions to consolidate more state governmental functions in Sacramento--moving them from the Bay Area. Nearly half the legislators must make their de facto home in Sacramento, partly because



DISTANCE COVERED IN ½ HOUR AT AVERAGE SPEEDS INDICATED

60 mph → AUTO, EXPRESS BUS, CONVENTIONAL RAIL

100 mph → TURBO-TRAIN

165 mph → TRACKED AIR-CUSHION VEHICLE

SSBACS — SACRAMENTO ▪ STOCKTON ▪ SAN FRANCISCO BAY AREA ▪ CORRIDOR STUDY

CHANGE IN POTENTIAL COMMUTER SHED — 0 5 10 Mi. — AMV DRA EDAW KE

Figure 41

of transportation problems. A faster system would permit certain government functions to operate more efficiently at any given distance. It would reduce the travel time of the trips per day now made for state business between San Francisco and Sacramento. The advantages of locating certain state government activities in the Bay Area could be maintained without suffering from the 90-minute travel time.

Specialized educational and medical facilities are extremely expensive. Nevertheless, the state is obliged to provide substantial duplication owing to the geographic separation between facilities. The economics offered by inter-campus commuting as educational costs continue to rise, suggest the potential for good transit servicing linking campuses. The TV cannot provide all educational experiences. The relationship between the University of California campused at Davis, Berkeley, Sacramento and San Francisco would be radically altered were it possible to take courses at each simultaneously. The systems with the highest speeds approach this possibility.

Also, hospitals require substantial population as a basis for highly specialized facilities. The new military hospital proposed for Travis and other specialized Bay Area hospitals could increase their accessibility to less mobile segments of the population throughout Northern California if connected to other parts of the region with a high speed transit system.

<u>Socioeconomic Units That Produce Goods and Services</u> -- This grouping of socioeconomic units includes both the private enterprise and governmental organization units already in the region which produce the goods and services used and consumed by other socioeconomic units. Categories included in this grouping are: footloose light industries; other light industries, heavy industries; regional office space developers and managers; regional shipping developers and operators; governmental organizations that develop and operate public facilities. These activities are affected in several general ways by improvements in intercity transit:

- The improved transit accessibility can give sales or managerial personnel access to more customers/ clients at the same cost, and can lower their selling costs per unit of product sold. This is likely to be a marginal benefit accruing to activities already well located in the larger cities.

- Improved accessibility can provide such activities with access to a larger, high quality labor supply at the same cost to the

organization and to the employees of that organization. Both in-and-out commuting can be expected to and from the East Bay, Sacramento and Stockton.

- The net effect of the above impacts can be to increase the quantity of economic activity and economic unit can undertake at its existing location (improve profits) and can improve the quantity and quality of goods and services provided by governmental units at the same cost.

- More intense use of the landat an existing location, and higher profitability or productivity of the activity on that land can increase the market value of the land and the improvementson the land (property value).

Residential Land Users--Residential land users are household socioeconomic units consuming goods and services and providing labor force. Improvements in intercity accessibility could produce the following general kinds of impacts on residential land users:

- From the employment standpoint, improved regional transportation system accessibility can give certain households access to more jobs at the same cost and convenience; and can offer lower cost/higher convenience access to the same jobs. This will be especially important in smaller cities between larger cities such as the Livermore and Fairfield areas.

- Improvements in regional transportation system accessibility to regional shopping centers, regional cultural centers, regional recreational centers and facilities, public facilities, and other households should improve the quality of life in the smaller cities most remote from the three metropolitan areas.

- Providing greater accessibility for households to the kinds of social and economic activities discussed above can improve the market value of the residential property on which the households reside.

The Transit Dependent Population--The transit dependent population is defined as those socioeconomic units that must rely on public transportation for movement throughout the region. This includes the young (students), aged, low income, and the handicapped, groups which through age, disability or income, do not drive. They are, denied independent access to the existing transportation system--the regional freeway and arterial system. An improvement in the intercity public transportation system, if it is provided at an acceptably low cost, will improve the accessibility of this group to the types of social and economic activity described above.

In particular, improvements in regional public transportation will provide accessibility to more jobs for the lower income, less skilled households now often constrained to live, partially because of lack of accessibility to a wide range of jobs, in older, deteriorating, innercity residential areas. Improved intercity transit would permit low income and minority groups to seek a wider range of housing opportunities in the region, including the advantages of low land and development costs associated with certain suburban fringe areas currently inaccessible by public transportation and isolated from low skilled employment opportunities.

As indicated in Figure 41, the areas included in a half hour line-haul commute to downtown San Francisco and Sacramento for the different technologies under study are expanded with speed. Currently, for example, Vallejo/Benecia represent the outer commute boundary--a 45 minute trip at an average line-haul speed of 60 mph. At an average line-haul speed of 100 mph a commuter could travel from Fairfield to San Francisco in the same time. At 165 mph it would be possible to live in the East Bay and work in Sacramento. Such a change in accessibility might have a major impact on the living and working patterns in the region. In essence, if the travel times in the San Francisco, Sacramento, and Stockton areas were reduced by half, the region wouldtend to become a coherent "regional city" with each major urban area able to play a more specialized role and avoid the inefficiencies of duplicated specialized activities.

In addition, a greater range of living environments, jobs, and recreation opportunities would be available within the same time as previously spent in travel associated with these activities. A more efficient regional structure would place Northern California in an improved competitive position to attract the type of economic activity it desires.

Interregional Competition

Aside from improving accessibility among existing activities, a second economic impact that improved intercity public transportation would have is attracting desirable economic activity to the region and spurring residential growth.

Improved intercity transit, by increasing labor force accessibility would affect those activities constrained in location only by a labor supply of adequate quantity and quality. These industries are typically high technology, R & D, and light manufacturing that produce a high value added and use low volumes of materials as inputs and produce low volumes of materials as outputs. The input and output flows associated with these industries are often in the form of data rather than in the form of materials. They have great locational flexibility, and as transportation system improvements provide better accessibility to new areas, they often locate in those new

areas, many times bringing their own labor force with them. Santa Rosa and the Livermore/Antioch valley areas are places where such industry has recently begun to locate in response to highway transportation improvements. For the transit improvements under study, industries of this kind are also likely to locate in increasing number in the Richmond/Pinole, Fairfield, Cordelia, Antioch and Brentwood areas.

Regional transit system accessibility would also open select new residential areas which could provide the same accessibility to jobs and the same residential amenities at lower cost than in existing residential locations. Vallejo, Fairfield, and Livermore/Pleasanton are examples of areas where this type of impact may take place. Improved desirability for residential purposes would be provided to land areas by improved regional transportation system accessibility, thus raising their market value. While such changes are likely to be modest since most transit stops reinforce the existing urban areas and their growth is at the margin, a major opportunity exists in respect to a new stop serving a planned community.

New Communities

There are over 40 communities in the three COG regions with a population less than 100,000 each which grew by more than 15,000 between 1960 and 1970. Constituting more than half the region's population during that period, they are not "new communities" in the conventional sense. Regional policies have focused on the need to develop a more guided growth for these developments in terms of transportation, environmental quality, economic opportunity, and local government rather than concentrating on establishing separate new communities.

The intercity systems under review suggest several new opportunities. The major impediment to new community development in terms of satellite to San Francisco and the Bay Area is available land. As Figure 30 indicates, much of the available land has constraints to development--poor bearing capacity, landslide or flooding potential, fault zones, prime agricultural land, or ecologically sensitive areas. Accessibility, however, has also been a major constraint. Typical American satellite new towns have been 20 to 25 miles, or less than one-half hour drive from metropolitan downtowns. Figure 36 when compared with Figure 30, communicates the absence of available sites of 5,000-10,000 acres within the 60 mph average speed, half-hour drive radius. Furthermore, most of the available land is in the northern counties whose highway and transit access is poor.

The implementation of a high quality intercity transit system connecting any of the three major metropolitan areas raises some new possibilities for semi-independent new towns. The most obvious and major opportunity is Travis Air Force Base. If the Regional Air System Study Plan designating Travis as a fourth regional airport is realized, such a development

would create a localized demand for housing and support facilities for which a controlled new community might provide an attractive alternative to continued growth of Fairfield and Vacaville. Other growth potential in central Solano County includes industrial parks, new hospitals, Carquinez Straits-related port activity. It appears that land and utility contraints may not be major constraints.

Another major opportunity relates to northeastern Contra Costa County where attention has, in the past, focused on the Brentwood Area. At the present, the distance from the East Bay, poor highway access, lack of utilities fragmented tenure and environmental problems have prevented more serious consideration of this alternative. However, a transit extension to Pittsburg-Antioch and/or a continuation beyond to the Brentwood area would make it a candidate. Such a development would depend on a strong connection to, or extension of, BART beyond Concord.

The major difference between the Travis and Brentwood opportunities is the degree of "self-containedness" achievable by a new community. It can be expected that a Solano County new community might have a local employment base resulting in short work trips and relatively close home-to-work living relationships. The major role of a new intercity transit connection to the Fairfield/Travis area would be to support the airport and associated economic activities.

In Brentwood, however, development would depend on a transit line which would be heavily used for commute purposes--both to the growing industrial concentrations along the northern shore of the county and to Oakland and the San Francisco Bay area beyond. Based on current experience, a new town of 75,000-100,000 could be expected to generate from 25-50,000 commute trips (plus traffic related to other travel purposes).

Finally, new community plans have also been underway in the Hercules area, a location which would be most affected by the continuation of BART or the establishment of a station for conventional rail at that point. At the present time, the Hercules site has relatively good but indirect access to the Richmond BART station.

Negative Impacts

The changes in land values which would be encouraged by a new intercity transit system would add to the pressure for developing areas at the fringes of the existing urban areas. The owners of agricultural and other rural land throughout the region often experience substantial increases in the market value of their land due to increased accessibility of the land to existing social economic activity around the region. As accessibility of such land is improved, its desirability for production/distribution

and residential activities increases and drives up its market value. The tax implications have been partially offset or at least postponed by the Williamson Act. Nonetheless, as accessibility improves, pressure for agricultural-urban conversion will increase.

In addition, the impacts of new transit can also work to the disadvantage of certain residential areas. If employers relocate due to improved transportation accessibility, the cost of accessibility to the same quantity and quality of jobs available to certain households may decrease. Improved accessibility to certain residential areas in the region can also diminish the attractiveness of other residential areas not sharing in the improved accessibility, and can cause the property values of this latter class of residential land users to increase less rapidly or even decline.

CORRIDOR ECONOMIC IMPACTS

The suburban fringe and rural regions between the three major cities and smaller cities in the region are classic urban sprawl, heavily oriented to single-family dwellings and low densities. The existing commercial centers generally provide only a few functions. Job locales are dispersed since footloose light industry has decentralized over the region. Work trips involve a complicated pattern of cross-commutes from dispersed home locations to dispersed job locations. Transportation is almost totally dependent on the private automobile, supplemented by Greyhound and two small local bus lines.

The land use plans and policies of the three regional governments within the region are oriented towards city-centered growth-- either building up existing communities or establishing new ones. The common goals in respect to regional land-use form among ABAG, SARPC and SJCCOG include:

- Controlling urban sprawl and protecting the natural environment.
- Building on existing communities so that they are large enough to be specialized.
- Conserving open space between them.
- Connecting these communities with a multi-modal transportation system.

In the Bay Area this city-centered regional controlled growth approach has been formulated into a "growth corridor" concept in an effort to concentrate the resources and facilities needed to solve the region's problems,

building on the existing corridors historically present due to the sequence of foot, water, rail, and automobile transportation systems. The long-range plan is to gradually redirect the current outward expansion towards corridors of nodal growth through coordinated transportation, basic industrial location, utility, and open space programs.

The SSSBACS study route and station location alternatives have been developed in combinations consistent with this strategy since it provides service to major existing population concentrations and minimizes negative impacts. The corridors within the SSSFBACS are shown in Figure 42 along with the locations of expected private development activity in the corridors containing intercity transit alternatives under study. These corridors, as delineated by MTC, are described below.[1/]

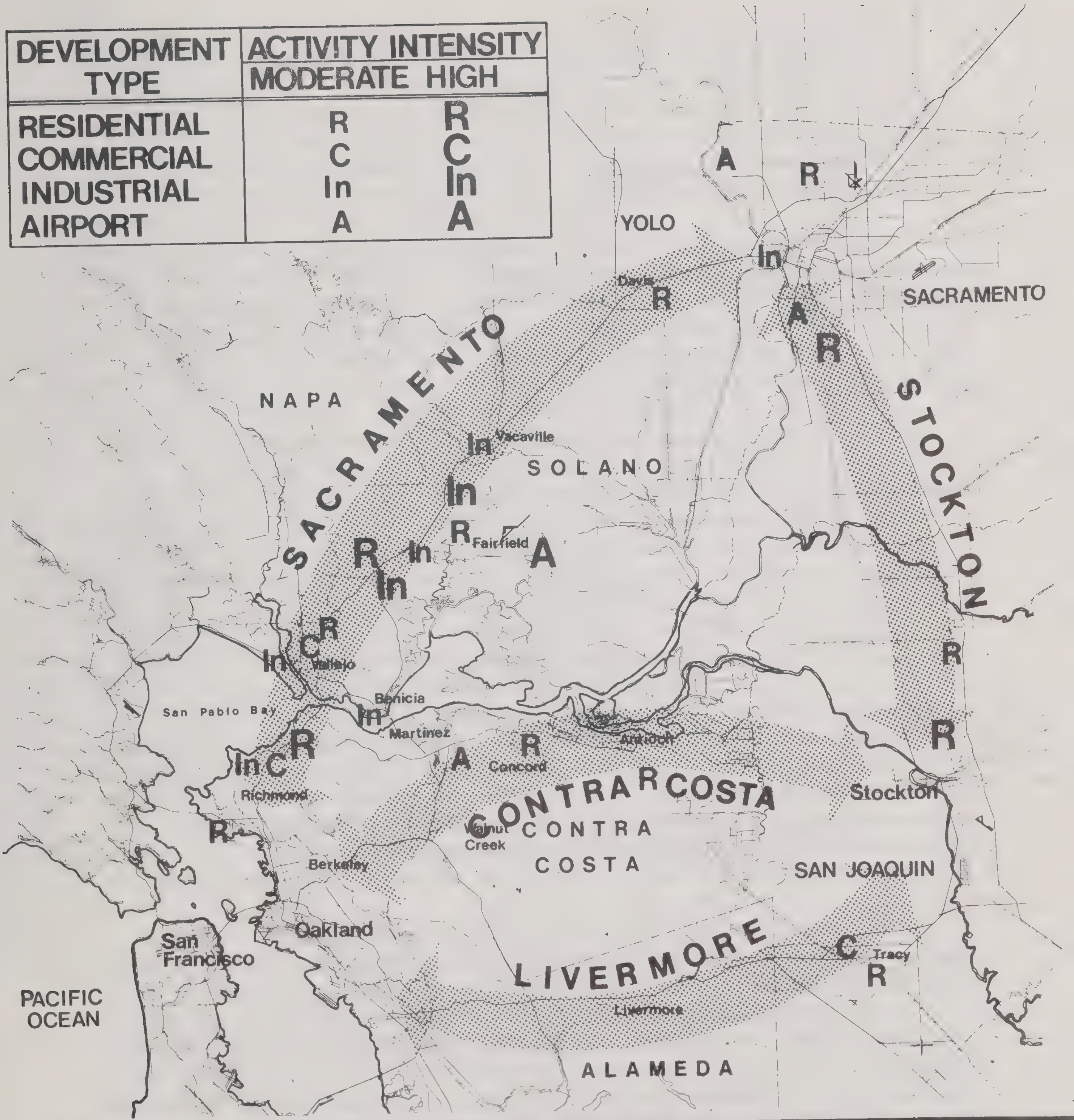
Livermore Corridor

This corridor comprises the areas in the Livermore Valley, and connects the Valley to the urbanized East Bay. The regional highway trunkline in this corridor, Route 580, traverses the corridor east to west. Another important trunkline circumferential freeway, Route 680, passes through the corridor from north to south. In addition to supplying service to persons in the corridor, Route 580 is a major regional facility linking the Bay Area to the Central Valley and recreational areas in the mountains. Weekend as well as weekday, and truck as well as automobile traffic, are important planning considerations. Transit in the corridor is non-existent at the present time.

This corridor is expected to grow substantially in terms of population and employment under either the Alternative Future I or Alternative Future III. An appreciable proportion of the work force in the corridor now commutes to work either in the San Jose or East Bay areas. The scale of significant employment opportunities and the prevalence of low density residential development will stimulate a rapid growth in automobile use and traffic congestion at peak hours. The Livermore Valley has a severe air pollution problem which is further threatened by increased auto use and continued growth. The consumption of open space will become a critical issue as development pressures mount.

The Fremont BART line has already improved access from the corridor into East Bay employment centers and the Trans Bay tube will complete the linkage to San Francisco. MTC and BART are currently studying a BART extension to the Livermore-Pleasanton area. As MTC puts it:

[1/] MTC, Proposed Regional Transportation Plan, June 1973.



SSBACS

SACRAMENTO·STOCKTON·SAN FRANCISCO BAY AREA·CORRIDOR STUDY

STUDY AREA SUB-CORRIDORS

AMV
DRA
EDAW
KE

Figure 42

If improved access in this corridor is to be constrained, then expansion of trunkline transit and highway service to other parts of the region becomes a critical issue. If improved access is compatible with a limitation of growth, the issue becomes one of determining the kind of service to be provided. If extension of trunkline transit, or expansion of the highway system is not sufficient to meet demand, a combination of transit and highway facilities might be warranted.

The Livermore-Pleasanton Valley areas offer good location for light industry, R&D and government employment. Several have located in the area with more projected in the future. This will continue to induce in-commutes. In terms of industrial or residential growth, the express bus alternative would not have the dramatic impact that may be expected with the BART extension currently under study.

Since the proposed express bus improvement alternative continues beyond the Livermore-Pleasanton area to Tracy and Stockton, its unique but moderate impacts would occur there. Primarily, this would be increased population growth associated with households taking advantage of an improved commute from the Tracy area to either the Livermore-Pleasanton area or to Stockton. The degree of access change offered by the express bus alternative is not large enough to expect employment generating effects.

One effect that increased accessibility through the corridor can have is to reduce growth in the most specialized kinds of regional shopping and entertainment facilities. Increased accessibility to both the Bay Area and Stockton would encourage people to make trips to those areas for such activities, thus reducing a demand within the corridor that is marginal at best for the location of such facilities in the corridor. This would include high fashion, high cost retail shops, major cultural and entertainment facilities such as music and the arts, and major sports facilities. The express bus alternatives can be expected to have a minor impact in this respect.

Improved accessibility in the corridor will have little effect on the population growth of the Stockton area because Stockton, in general, is relatively less competitive as a place to live, work, and do business if a locator is free to select from among the immediate Bay Area, the Amador-Livermore Valley, the Walnut Creek area, the Pittsburg-Antioch area, and even Sacramento. Under almost any set of reasonable accessibility and economic assumptions about the future, Stockton will remain an agriculturally oriented regional center with a low growth rate.

Central Contra Costa Corridor

This corridor comprises the Martinez-Pittsburg-Antioch areas, Central Contra Costa County, and the tunnels through the hills to the urbanized East Bay. Highway trunkline service is provided by Routes 680 and 24, linking this corridor to the East Bay and San Francisco. Route 4 traverses the northern part of this corridor east to west.

Major portions of this corridor are urbanized areas, but there are parklands, the Bay and other open space which would be sensitive areas if expansion of existing highways were undertaken. Generalizing for the corridor, the air pollution problem is a significant one, especially around Walnut Creek. Urban growth and development have been occurring at a rapid rate, concentrating in low density suburban bedroom communities characterized by high-income, single family residential development.

The introduction of the BART line to Concord, in combination with Greyhound bus commute service, has relieved congestion somewhat although the demand for BART exceeds its current capacity. However, urban transit access is spurring further growth which, in turn, generates automobile trips for non-commute purposes. A current dial-a-bus study may provide a partial solution to this local circulation problem as well as offering an efficient feeder service to the BART system.

Currently MTC and BART are studying a BART extension from Concord to the Pittsburg-Antioch area. These studies indicate that this extension should have a substantial impact on the Pittsburg/Antioch residential growth, improving commute possibilities to the Concord/Walnut Creek areas as well as to the East Bay and San Francisco. In addition, industrial growth and urban renewal in the Pittsburg/Antioch area would be stimulated somewhat, depending on which BART extension route is selected.

In respect to intercity connections between Antioch and Stockton, the major impacts are likely to be in the Brentwood area, including the rolling hills west of Brentwood and the Delta fringe east of Brentwood. Land is now cheap in this area, easily developable, and offers an attractive physical environment for low density living and working. The Brentwood area is still primarily rural in nature because it has poor accessibility to Bay Area employment, shopping, cultural, entertainment and sports centers. A rail connection from Antioch (or Concord) with a stop at Knightson (Brentwood) and Stockton, even if not commuter-oriented, would improve accessibility substantially, given the poor highway connections east of Antioch. Improved accessibility to those centers would stimulate growth in the Brentwood area. The scenario of "leap frog" growth would probably take the following form:

- Residential developers would start putting tracts to the southeast of Antioch for residents working in Antioch, Pittsburg, and the Concord-Walnut Creek employment concentrations. As the best land is used up, these residential developments would progress south along the hills and foothills toward Brentwood. A Knightson station, serving the Brentwood area, would provide the focus for this development.

- Simultaneously, some water-oriented residential developments similar to Discovery Bay would be started along the Delta waterways. The residents of these water-oriented developments would commute to the same employment concentrations.

- As the population builds up, population serving activities and employment will be developed at a pace equal to the demand created by the population growth. As the population increases pass 30,000 or so, and the work force represented by that population increases accordingly, non-population serving employment creating activities will move into the area to take advantage of the resident work force. The increased work force in close proximity to the heavy industrial areas around Pittsburg will make these areas more attractive as the location for additional heavy industry, thereby increasing the growth rate of employment in that area.

- This process of population and employment growth will proceed rapidly until the Brentwood area becomes a self-contained, outlying population and employment center. A high growth in population and employment has been projected for this area under the Growth South and Growth North alternative futures. The apparent opportunity for the creation of a free-standing satellite new town in this area has been discussed.

The Delta area in this corridor would experience some increased pressure for recreational facilities in view of increased population in the Brentwood area. Unless the recreational usage and recreational facilities in the Delta is tightly controlled, the unique and fragile environment of the Delta which provides its recreational attractions and amenities, could be seriously damaged. However, it is unlikely that residential or other kinds of non-recreational developments would take place in the Delta because of the danger of flooding and the highly unstable soil conditions which make it extremely expensive to build.

Stockton might experience a small increase in its employment and population growth rates, primarily resulting from the large population concentration in the Brentwood area or the immediate Bay Area. However, since the effect on Stockton will probably be small, the Walnut Creek and Bay areas are much more attractive in terms of regional shopping, culture, sports, educational facilities, and other urban attractions than Stockton is likely to be. In addition to the degree the Brentwood area does grow to a substantial size, it would develop its own set of regional facilities which will compete with Stockton.

Sacramento Corridor

This important interregional corridor connects the dense urban core of the Bay Region to Sacramento and points east. Route 80 provides the principal north-south highway service, crossing the Sacramento River at Crockett, then running northeasterly through or alongside the growing Solano County communities of Vallejo, Fairfield, Vacaville, and Dixon to the Yolo County line. Routes 21 and 680 enter the corridor in the south at the Martinez Bridge, providing important linkages to central Contra Costa County. Route 505 leaves Interstate 80 east of Vacaville and connects to Route 5 in Yolo County. Greyhound provides limited trunkline service. Vallejo is the only city with a local transit system.

The corridor is rich in agriculture, has an abundance of scenic, wildlife and recreational resources, and possesses one of the region's strongest economic base potentials. The long-standing balance between these resources is now in jeopardy with the emergence of strong development pressures. These pressures, most noticeable in the Fairfield and Vacaville areas, threaten to transform the corridor into a strip city from Fairfield to Davis.

In the absence of stronger land development controls, the impact of improved transportation service in the corridor becomes a more important factor in determining the location and extent of urban development. Increasing trunkline highway capacity will further encourage the perpetuation of low density, sprawltype development. Intercity transit service as an alternative, in conjunction with local transit service, would provide a means of improving mobility and encourage compaction and densification of urban development.

The impact of the different improvement programs will vary, depending on the level of service offered by the specified alternative. The typical "leap frog cycle" can be expected. In response to decreased travel times between Solano County and the East Bay/San Francisco or Sacramento, an increase in commute-oriented population can be expected where other

development constraints are minimal. As this work force grows, local service populations will expand as well. Central Solano County will quickly become an increasingly attractive location for footloose, light industry, R&D and office type employers who will take advantage of the local work force, lower land costs, a potential new airport, improved ports, and accessibility to both the Bay Area and the capital.

The impact of improved intercity transit service will be a function of both the level of transit service and the level of automobile service. Under a high-cost, scarce-energy assumption, and assuming transit service in the corridor equal to or better than the automobile, population growth will probably be accelerated because of accessibility to East Bay jobs. On the other hand, the high energy cost will increase the cost of transporting materials substantially, as well as increasing the cost of business trips that certain employees must make by auto to the Bay Area or Sacramento. These increased costs of doing business will tend to slow down the location of employment creating activities of the kinds mentioned previously, since many of these activities will find it more profitable to locate in the East Bay area where material transportation and business trip costs are lower, and accessibility to a large skilled work force is still good. Under this energy assumption, therefore, population would grow more rapidly than employment. Under the other energy assumption, with relatively cheap and abundant energy as in the past, both population and employment can be expected to grow more rapidly.

The existing development in the Fairfield/Vacaville/Travis area and the attraction of Sacramento as a large, rapidly growing population and employment center lend this corridor its unique characteristics. Improved accessibility will increase population growth in the Pinole, Hercules, Rodeo/Crocket area; the pattern depending upon station locations. This strip will become more accessible to the East Bay and San Francisco employment concentrations. The viability of the proposed Hercules new town can be improved as a result of the station serving the Pinole/Hercules area within BART Continuation Alternatives. Increased residential development can also be expected in the Vallejo area, with much of the additional work force commuting to East Bay and San Francisco jobs in the rail alternatives.

Additional commute-oriented households can also be expected to locate in the Cordelia/Fairfield area for all alternatives; traveling to jobs in the Vallejo area, the northern East Bay area, and possibly even San Francisco. This would provide a "leap frog" type of impetus to the Cordelia/Fairfield/Vacaville area similar to that discussed previously. In addition, this area is now experiencing appreciable growth in nonpopulation-supporting

employment-creating activities, primarily through the development of several large light industrial parks. Just as in the Livermore Valley, the rate at which this nonpopulation-supporting employment grows in the future will be a direct result of the energy situation. Higher costs and scarcer energy will appreciably increase the cost of doing business in relatively remote locations such as this. The higher cost energy situation would thus reduce employment, population, land use, and structure space growth in the area appreciably from what it would be in the lower cost, more abundant energy situation.

However, under any of the possible future energy situations, the Fairfield area is likely to experience substantial growth because it has excellent railroad service, a mode of transportation for moving materials that will be quite cost-attractive in the future under a high cost energy situation. Business enterprises that can ship their materials efficiently by railroad (as opposed to long distance truck shipment), and effectively utilize a growing work force in the area, should continue to be attracted to the Fairfield area. Land is relatively inexpensive and easy to develop in the area, and the environment is quite attractive to residents. This means that improving commuting accessibility to jobs outside the area or increasing nonpopulation-supporting jobs in the area should attract residents and residential developers to the area at a relatively high rate. In addition, military activity and potential airport development will provide a solid base for future growth.

For all alternatives, improved accessibility throughout the corridor also means improved accessibility of the Fairfield/Vacaville area, particularly Vacaville, to employment and urban activities in Sacramento. Some residents may choose to locate in Vacaville and commute to employment in Davis or Sacramento. This will increase the pressure for population growth in the Vacaville area and in the corridor immediately adjacent to the transportation system between Vacaville and Sacramento. The effect of this on the general rate of growth in the Fairfield/Vacaville area will be similar to that discussed previously for residents in the Cordelia/Fairfield area who would commute to Bay area jobs.

Many workers already live in Davis and commute to jobs in Sacramento or live in Sacramento and commute to jobs in Davis. Improved accessibility between these two areas would create a favorable climate for growth employment and population growth in each, depending on local land use policies. Clearly, the potential impact would be stronger on Davis since it is considerably smaller than Sacramento. In addition, Davis, and the UC Davis complex, would be more accessible to the whole Bay Area, which should produce the basis for slight increased growth rate for the downtown Davis area.

The transportation system terminus in western Sacramento, planned in common for most alternatives, would support the plans for development in the immediate terminal vicinity, including the recreation, cultural, and potential urban renewal activities. However, it is difficult to judge the impact of improved intercity travel times on the growth of the Sacramento area as a whole. With the state capitol being located in Sacramento, a large number of business trips are already made between Sacramento and the Bay Area. Many of these trips have little discretionary freedom. Improved accessibility between Sacramento and the Bay Area (a lower cost for a given trip time or a lower trip time giving cost), will induce a small number of business trips. However, it does not appear that accessibility improvements of the kind under consideration for this corridor will materially affect the overall growth of the Sacramento area since it is primarily dependent on factors related to state government, federal military installations, and agriculture and business. The transportation factors involved in the location decisions of these activites will probably be affected very little by the accessibility improvements under consideration for the corridor. The major impact on travel patterns will, in all likelihood, be a shift in modes.

One general impact to be expected from improved accessibility along this corridor is an increased rate of conversion of agricultural land to urban uses. Much of the land in the corridor is now used for grazing and crop production. Increased growth in nonagricultural population and employment will require large amounts of acreage for residences and employment creating activities. This acreage will have to come primarily from land that is currently in productive agricultural use.

Stockton Corridor

This corridor comprises the section of the Central Valley between Stockton and Sacramento. It is the least settled of the four corridors and is agriculturally oriented with some suburban communities commuting towards Stockton and Sacramento. The major trunkline highways in the corridor are 99 and I-5 which is still under construction. Following its completion, this corridor will have a superabundance of high quality freeway service. There are no major east-west highway facilities between Stockton and Sacramento. Transit in this corridor consists of Greyhound and one small local bus line. This corridor is not expected to grow substantially in the future except for those areas which provide inexpensive suburban locations oriented towards Sacramento and Mather Air Force Base. Residential activity between Sacramento and Stockton which is not commuter is largely agriculturally oriented.

Improved accessibility in this corridor as represented by regular rail service would not have a substantial affect along the corridor itself. The major impact would be to dispose Sacramento-related residential development further south.

LOCAL IMPACTS

The effects of improved intercity access on the economy of cities with stations is highly correlated with the degree to which the transportation service itself and the concentration of access at a given point in space reinforces the existing or planned economic structure of the area. The discussion below focuses on the potential in each town associated with a station or terminal location in that town. No distinction is made in this discussion among the different rail systems. While the "pass through" passenger traffic at a given station will vary with each alternative, the difference in impacts will, for the most part, be of one degree.

Richmond

The Richmond BART terminal is a major access point from the region into the East Bay and, eventually, into San Francisco. The line will be ultimately capable of handling from 10,000-15,000 passengers per hour. The station is located in an area with substantial potential for physical change--and could be conceived as a supporting element in an urban corridor which includes the new Civic Center, a public park, and a CBD in need of revitalization.

The BART construction is beginning to reinforce the Richmond area's environmental potential for residential development and will also improve its attractiveness as a location for major employers such as heavy industry or government offices.

The Singer and Hercules development plans, the expected Kaiser Hospital, and the HEW office provide examples.

The establishment of Richmond as a station or terminus on an intercity line to Sacramento will have a continual effect on these existing stations--particularly on the attractiveness of Richmond as a point of high accessibility for employers, providing access to an even wider area of relatively low cost residential areas for labor force to the north. Government offices may also take advantage of the improved connections both to San Francisco and Sacramento. Construction of a new transfer station will provide the opportunity to capitalize on the deveopment potential for facilities immediately adjacent to the station, a potential missed in many outer BART stations.

The major negative impacts on the development of Richmond will be increased automobile traffic and the need for more parking. In addition, the elevated intercity transit structure will reinforce the barrier between the residential and industrial areas to the north of Lincoln Avenue.

Pinole

A station at Pinole (Willow/San Pablo Avenues) would be a low density park-ride station with little immediate economic effects. Its major impact would be to provide improved access to the industrial areas nearby and to enhance the potential of the major residential developments in several stages of realization in the area.

Vallejo-Rail

Vallejo has traditionally been a one industry town, dependent on Mare Island. More recently both Vallejo and Benicia have been developing a diversified industrial base. The location of an intercity transit station in Vallejo will improve its advantages as an industrial location by making it accessible to residential areas both east and west and will assist in overcoming the Carquinez Straits as a psychological barrier to becoming an integral part of the San Francisco metropolitan area.

Two obvious station location possibilities are the intersection of the Southern Pacific Vallejo Branch with either Tennessee Street or Georgia Street. Both locations are at the ends of commercial streets. Neither is directly in the CBD. Either station location could provide an anchor to the commercial development on the streets. Tennessee Street offers available station and parking sites with minimal relocation or disruption. The Georgia Street site borders the transition between residential and commercial. The rail stations will offer a focus for commercial and office development in this location, capitalizing on the increased exposure to rail patrons.

Connections to I-80 and major routes serving northern Solano and Sonoma Counties are not as good as a possible park-ride site further east, but the initial choice is consistent with a general urban revitalization strategy.

The elevated configuration of the rail alternatives in the Vallejo area will have a negative impact. While the Vallejo Branch separates residential and commercial or industrial areas in some blocks, there are several areas where the alignment comes very close to existing houses. The elevated structure and the more frequent rail traffic will introduce increased visual and noise disruption and tend to increase the severence of this residential neighborhood east of Georgia Street.

Vallejo I-80 Bus Pad

The bus pad location on the I-80/680 interchange apron is well located for access from the Vallejo and Benicia areas by automobile or by local transit and attractive to the greatest number of southbound parks and patrons. Adequate space exists in the northern quadrant of the interchange for the pad itself although a special ramp will be required to insure safe access and egress. It is not expected that this facility would spur any local development.

Cordelia

Two Cordelia stations are planned for rail alternatives. The choice depends on which of two alignments are followed--along the Southern Pacific to Central Cordelia or along I-80 to the intersection of I-80 and Route 21.

The downtown location is at the historic center of old Cordelia with direct access to Rockville and Green Valley via main roads and one-half mile from the Route 21/I-80 interchange. There is enough vacant land for station construction in an area currently planned for light industry and warehousing. However, two other current proposals offer prospects for a more significant contributing effect. The first is a proposal to restore the historic townsite. If the route was carefully treated to minimize incompatability, a new station could be designed to interrelate the station with refurbished shops, cafes, and other commercial and tourist-oriented activity. A second approach to the Cordelia area is represented by a plan to develop Cordelia as a new community with major residential development as well as an industrial base. An intercity stop would assist in the establishment of Cordelia as an independent community. However, this may conflict with its role as a satellite to Fairfield

Fairfield

Two locations for rail alternatives have been developed for Fairfield. Rail RE and Rail RN use the existing Southern Pacific track and have their Fairfield station location at the Route 12/SP intersection. This location is three blocks south of the County Court House and offices, and three blocks northeast of the Suisun shopping area. Potential station locations are to the south of the tracks which are largely vacant and adequate for both station and associated parking. The projected extension of Highway 12 to I-80 would provide excellent regional connections and minimize the attraction of new traffic through downtown Fairfield or Suisun City. The conjunction of county buildings, station and commercial opportunities (with the Highway 12 interchange just south of the site) could provide the framework for development of that area.

The second station site possibility (RN highway) is at the intersection of the abandoned Sacramento Northern Railroad and Air Base Parkway. This site is in a relatively vacant lane surrounded by residential development. It has good access via highway and is closer to the new expansion areas of Fairfield. There are no major non-residential activities in the area and a station location in the area would not be in accord with local plans. The station itself would be below grade and relatively unobtrusive. A major shortcoming would be the "back tracking" required by the majority of southbound users.

Fairfield Bus Pad

The north side of I-80 provides adequate vacant land for pad, parking and support facilities. Access via I-80 and Air Base Parkway would be good. Little development potential exists.

Davis

All the rail-based alternatives contemplate use of the existing Southern Pacific Railroad. This station is already used by Amtrak and is well located in respect to the City, the University, and I-80. There is convenient access to the CBD two to three blocks to the north and campus access by bicycle or shuttle bus would be easy to achieve. There is sufficient vacant land for parking with good local street access as well as land for station-related development. A number of small older houses are close to the tracks to the south and would be adversely impacted by the elevated configuration associated with the BART and RN alternatives. Increased accessibility to the station area would encourage conversion of these units to a higher density use.

Sacramento (Bryte)

An elevated TACV station at the I-80/880 interchange would be built on vacant land adjacent to the interchange. Good highway access to Sacramento is present. No displacement would be required. No major development opportunities exist, other than those generated by the station itself, which might foster improvement of a now depressed area.

Sacramento

Several Sacramento terminal sites are available from an engineering point of view. These include the existing Southern Pacific Depot (for Rail RE) and new elevated station north or south of I-Street, east of west I-5. Considerations bearing on the choice include:

- Impact on the environment of the Old Sacramento Restoration.

- Impact on Railroad Museum

- Parking space and circulation given historical and railroad activities.

- Possible "new town in town" urban renewal opportunity over adjacent Southern Pacific railroad yards.

All of the above sites can be connected with downtown Sacramento via SRTD buses and an eventual extension of the Mall transit system. Rail RE, since it uses existing track, can logically make use of the existing Southern Pacific Depot with potential for a direct above or below grade pedestrian connection to the proposed 3rd and J SRTD bus terminal. Alternatives involving construction of a new elevated structure can avoid both visual impact on the historical area and operating congestion by utilizing station sites to the north of I Street. A site adjacent to the old Southern Pacific Hospital does not require the guideway to pass over the highway which would add to its visual obtrusiveness.

However, pedestrian access to the SRTD bus terminal would be more remote and automobile access for park-ride less direct. The site at 4th and H, adjacent to the existing Southern Pacific Depot would require considerable elevation but might be more closely related into a renewal scheme involving use of railroad yards. The site south of I Street brings the terminal into close conjunction with the historical area introducing a new structure which would be out of character with Old Town, but offers the interesting possibility of a joint railroad station/museum. As indicated elsewhere, the impact of the station on the historical restoration or the urban renewal plans under consideration can be positive if a strong public role to achieve the maximum potential for joint development is taken.

West Pittsburg

The impact of an intercity transfer station to a BART station at West Pittsburg, (Suisun Avenue and North Broadway) would be to intensify those activities which would already be induced by the location of a new BART station. A substantial spur to the residential development of West Pittsburg can be expected to result from the combination of these facilities. The additional impact of the intercity system would be to require more space--for rail and transfer facilities as well as for parking. Access facilities and impacts would not be changed were those required by the proposed BART station alone.

There is adequate vacant land for the station area development anticipated with the introduction of a BART station. These and related issues are covered in the Pittsburg-Antioch BART extension studies currently under the sponsorship of BART and MTC.

Antioch

Antioch would represent the eastern-most BART extension. As a transfer point to a rail line to Stockton, the impact of a BART station would be increased, but the nature of the impacts, discussed in BART impact studies, would remain unchanged.

A cross-platform station would be established at the proposed I Street BART terminal, three blocks northwest of City Hall. Integration of station support facilities into the downtown commercial patterns is contemplated under a proposed renewal strategy with BART support. The rail service from this point would reinforce this potential as outlined in the Pittsburg-Antioch BART extension studies. The major negative impact would be encroachment on marshland adjacent to the proposed station site.

El Cerrito

The El Cerrito Del Norte BART Station would serve as an intermodal transfer station between BART and the beginning of the bus alternative system serving Bay Area passengers. The overall impact of such a transfer point would be reasonably low due to the direct access to I-80 on high volume surface streets and compatibility with existing and expected commercial office, and high density residential uses around the already active BART Station. The more adverse effect of such a proposal would be the additional bus traffic generated on surface streets. Roadway demand is already approaching capacity on San Pablo Avenue in the vicinity of the Station. Also, major displacement impacts to surrounding uses may be incurred if heavy use of this bus operation necessitates later enlargement of existing parking lot and support facilities.

Livermore

The bus pad at the I-580/North Livermore Avenue interchange can be constructed with park-ride facilities on available vacant land. There is adequate vacant land to accommodate all required support facilities with any displacement of existing facilities, though it is in an area of prime agricultural soils which would be protected from development. There is excellent access to the CBD. However, the station is not central to community activity, and vehicular access of most residential areas served by the station would be long trips on surface streets. Arroyo las Positas, which flows close to the site, would be subject to siltation and erosion unless the apron and support facilities are carefully sited.

Tracy

The bus pad at the I-205/Tracy Boulevard interchange can be constructed on available land. The site is central to much of the new residential development and a new shopping center with good access to the CBD by automobile and bus.

Stockton-Bus

Location of a central city depot for the bus alternative in the vicinity of Market and Center Street would require displacement of substandard buildings presently on the site. Redevelopment pressures generated by this pedestrian-oriented station could lend impetus to urban uplift activity presently underway in the FACE and redevelopment areas adjacent to the site. Major problems with this site include the increase in vehicular traffic in the CBD by users arriving by car and delays in the bus operations due to the utilization of surface streets in a congested downtown area.

Stockton-Rail

Two stations are under consideration. The Santa Fe Station is at the western fringe of the downtown. It has indirect access from the crosstown highway and one bus connection to downtown. It is an area of vacant and industrial land with relatively little development potential.

The existing Southern Pacific Rapid is better located. It is still not convenient to the highly depressed CBD area, although it has good bus and highway access.

Lodi-Bus

The bus pad at the interchange of I-5 and Highway 12 would be a low intensity suburban park-ride type facility requiring no displacement of existing facilities. Access to the site is excellent, and it is central to the major development activity in the Lodi area. Lack of proximity to CBD and necessity of vehicular rather than pedestrian access are weaknesses in this site location.

Lodi-Rail

A major strong point in this location is the close proximity to the centroid of the CBD only four blocks to the west. Access to the site is good and surrounding land uses would be compatible to increased station operations. Displacement of some industrial and/or residential facilities would only become necessary

if substantial new parking were required. Noise impacts to local residents would increase compared to the existing low ambient noise levels of this rural community. There would also be an increase in vehicular activity in downtown areas due to need to travel to CBD to use facility.

STATION IMPACTS

The areas in which most of the proposed transit stations are located are, generally speaking, older, relatively static parts of cities where change is heavily dependent on public support and initiative. The addition of a new intercity transit station in an old downtown or newer commercial area of an existing city can establish an opportunity for change in the potential land use providing the highest return on investment or the maximum social benefit. Such changes occur only when specific people, primarily land developers, take actions to change the structures and facilities and other improvements in the station neighborhood. Two major classes of factors largely determine the actions land developers will take to make such changes:

- Economic incentives--All other things being equal, construction of a station in a given neighborhood, and the vehicle and people movement it generates, can create new economic incentives for land development.

- Government constraints and incentives--Actions by government can set the limits on what a developer can do with a given piece of real property in responding to a given economic incentive such as the profit potentials offered by a new station. Location of the station itself is, of course, a government policy action which provides a land developer with an opportunity. Other government policy and control actions which constrain the developer to provide him with opportunities include: zoning, provision of supporting infrastructure systems (such as streets, water systems, and sewer systems), building and safety regulations, and real property taxation policies or assembly of land by a government agency such as a Redevelopment Authority.

Activities Attracted to Station Areas

Certain kinds of land uses and structures, and the socioeconomic activities associated with them, will have a tendency to develop in the neighborhood of stations. The speed and desirability with which existing land uses are transitioned to new land uses through private development will be, to a large degree, a function of the land use planning and control actions

taken by local government. Whatever planning and control actions taken by local government, they should be based on the demand for certain kinds of socioeconomic activities that would be created by construction of a new station. The kinds of activities for which demand might be created at an intercity transit station include:

- The sale of retail goods and services: The movement of people into and out of a station, either in vehicles or as pedestrians, creates a potential for the sale of retail goods and services to those people. An important consideration in the location of specialty retail establishments is their placement where an adequate flow of people (patronage) with adequate incomes and dispositions to buy goes right pass the establishment. Certain small-scale retail goods and services could be expected to develop immediately adjacent to the stations where the people flows can be tapped for sales. Stores of this kind would include food service, stationery, drug, news, liquor, florist, and music stores.

- Community office space: Community office space is defined as easily accessible space that houses activities serving the needs of the local community. A station, with its flows of people, provide this type of location. The kinds of activities that are typically housed in community office space would include: banks, savings associations, household finance establishments, insurance sales establishments, real estate brokers, dentists and doctors, community organizations, legal services, accountants, etc.

- Regional office space: Regional office space as used here is defined as office space housing activities that serve wide regional or even national and international markets and customers. Such activities have considerable flexibility in locating throughout the region they serve. An important consideration in their location decision is the accessibility of their office to their clients and to others with whom they must do business. A station on a high-speed regional transit system can provide attractive accessibility possibilities if other factors about the station location are favorable.

- Hotels and motels: Hotels and motels can serve both community and regional markets. Most hotel/motel development around stations would be of the regional service variety developed only as a complex of other regional service type facilities, such as regional office space and light industrial complexes, is also developed nearby.

- <u>Government facilities</u>: Government activity, particularly those housing office space, may be developed by local, regional, state, and national government around stations to improve accessibility.

- <u>Residential activities</u>: Housing developments can be expected to cluster around stations which provide, through the regional transit system, good accessibility to jobs and regional facilities not existing in the immediate community. Higher density apartments and condominiums would tend to cluster within walking distance of a station. Further away from stations beyond walking distance, but within short drives or bus rides, land developers would be encouraged to develop lower density types of housing such as single family detached and attached homes for persons and households who generally have cars but prefer to use a regional transit system for longer, regular trips such as the daily journey to work.

The next ring of development, moving outward from the station, can be expected to include higher density activities which require more land area such as large retail establishments, motels, low rise office space, more extensive government facilities, low rise apartments and condominiums, sports facilities, large commercial recreation facilities, and hospitals. Many of these would still be within easy walking distance of the station. In some configurations, if the land is available and its location is compatible with other uses, light industrial parks might be developed in this ring. Beyond this ring, as the distance from the station increases and pedestrian accessibility to the station becomes less attractive, lower density kind of developments relying on automobiles or bus routes for station accessibility can be expected to develop. This would include lower density kinds of housing, light industrial parks, office parks with separated low rise office buildings, large sports facilities, and large government facilities. This classic form of station development cannot be expected to occur around intercity transit stations in its full form. However, certain aspects of intercity stations may approximate the classic forms.

An excellent example of the type of development patterns that can be expected around a station, and which will create the station vicinity impact if they are developed, can be found in the community and town centers that were developed in the past around railroad stations before use of the automobile for movement became so pervasive. These older town and community centers, several are still to be found in the study area, grow outwards from the stations in a manner similar to that described just

above. In most cases the growth of these older centers occurred without local government planning and control because the centers developed in an era before local governments planned and controlled. Development of equivalent kinds of activity centers around stations today, however, particularly in already developed neighborhoods, would require strong government planning, control and incentive policies, programs and actions.

Typical Development Patterns

A typical development pattern around a transit station, particularly if the pattern is planned and encouraged by local government in response to socioeconomic demands, would be for retail goods and services establishments to be developed immediately adjacent to a station, if not in the station structure itself. Candidates for development immediately adjacent to the station would be higher density structures such as community office buildings, regional office buildings, and government office space. Retail establishments frequently are located on the ground floors of such buildings. Mid- and high-rise residential structures, and mid- and high-rise hotel/motel structures also can be expected to locate closest to a station.

Importance of Local Government Land Use Controls

The degree of control exercised by local government on land use in the immediate vicinity of a new station (out to approximately one-quarter mile from the station) will be a critical determinant of the socioeconomic impact generated by the station in its vicinity. For a given level of vehicle and person movement generated in the station vicinity, the more local government acts to plan and control land uses to take advantage of station-generated movement, the greater the socioeconomic impact created in the vicinity of a station.

In general, the structures and improvements in a given neighborhood, and the socioeconomic activity which is housed in and uses those structures and improvements, change only slowly over time and change in a haphazard, uncoordinated fashion if government does not take a strong initiative in planning and controlling what happens on the land. Without government incentives and controls, certain parcels of land in the station vicinity will be redeveloped or developed privately in uses appropriate to the station location, other parcels will be developed or redeveloped in uses inappropriate to the station location and incompatible with adjacent land uses, and other parcels will remain in their existing uses (whether appropriate or inappropriate) indefinitely.

Furthermore, the development or redevelopment of any parcels will take place slowly over time because the developer must get zoning changes or variances on a spot basis, work out arrangements with local government

over inappropriate building and safety regulations, and changes in the supporting infrastructure. The result is a slow, helter skelter, unattractive, inefficient pattern of land use and structure change around the station accompanied by expensive and uncoordinated changes to the supporting infrastructure in the neighborhood. doing little to improve the station neighborhood from the social, economic, urban design, and cost/revenue standpoints; with the impact being felt only slowly over a long period of time.

The strongest, quickest, and generally most desirable type of impact in a station neighborhood occurs when government plans and encourages orderly and desirable change in the neighborhood in response to construction of a new station. The most critical action that can be taken by government to insure such kinds of changes is acquisition of land surrounding the station and redevelopment of that land according to a plan by a government authority. Other important actions involve development of a plan for the neighborhood, and then appropriate changes in zoning, building and safety regulations, property taxation policies, and supporting infrastructure to encourage private redevelopment of the land and structures in accordance with the plan.

Government action is particularly significant around stations located in older urban areas which is very little economic incentive for a land developer. Such neighborhoods are often characterized by older, deteriorating structures and infrastructures, lower-income households, and a variety of social problems. Introduction of a new station may not provide enough economic incentive to cause new private development to take place by itself without strong government incentives and assistance through acquisition and redevelopment of land around the station is probably required. At the very least, a coherent government land use plan, strongly enforced and encouraged, is necessary, and even then changes/impacts may occur only slowly and sporadically over time. This is the case with many of the station locations under consideration.

Unless there is coordinated and comprehensive governmental action, the indirect economic benefits of large public investments will not be capitivated at all or captured partially by individual developers.

IV.

IV. INSTITUTIONS AND IMPLEMENTATION ISSUES

This section sets forth the issues involved in selecting an appropriate institutional (organizational structure and jurisdiction) and financial plan arrangement for planning, designing, constructing, operating, and maintaining the alternative transportation improvements in the Sacramento-Stockton-San Francisco Bay Area Corridor. Alternative institutional arrangements are presented and the potential role of the State is examined; organization for and steps towards implementing specific improvements are presented.

The institutional issues in this study are relatively unique in that they relate to implementing interregional public transportation improvements. While the authority and responsibility for coordinating, planning, and implementing of the State's interregional and rural highway system is clearly specified at both the State and Federal level, there is no comparable specification of responsibility for interregional public transit facilities. Although AB69 (Section 14000.5) expanded the public transit function of the State by directing the State DOT to encourage and stimulate the development of urban mass transportation and interregional high-speed transportation, it restricted the DOT from direct project planning, implementation or operation without further legislative authorization. Such restrictions are not present with regard to the general planning for such systems and the consensus is that AB69 enables the DOT to undertake systems planning, including corridor planning, for interregional transit facilities.

The following discussion points up the fact that the institutional arrangements and financial programs will vary in accordance with the particular types of interregional transportation services desired and with the stages involved (from planning to operation) in achieving a balanced approach to corridor transportation. In investigating these issues the STB conclusion contained in its Section 13991 report (January 1973) to the Legislature on jurisdictional roles was used as a key policy guideline. This section stated that:

> "Authority and responsibility for construction and operation does not need to pass to planning agencies--State or regional--in order to have effective plan implementation. Nor do planning agencies necessarily have to have complete control of resource allocation in order to implement their plans. There is no intent by the State, under AB69 or through its policies, to place regional transportation planning agencies in a position to control the day-to-day affairs of constructing and operating agencies, public or private."

POLICY BACKGROUND ISSUES

Prior to discussing the specific organizational options which are available for consideration, the following sections describe four issues which should be considered in any final determination. These are:

- Coordination of Transportation and Land Use Policies
- Intermodal coordination
- Inter-jurisdictional coordination
- Priority determination

Coordination of Transportation and Land Use Policies

It is generally recognized that land use and transportation constitute interacting systems. Because of these linkages between land use, transportation, and other systems (e.g., water, sewage, disposal, and public utilities) the Section 13991 report concerning transportation roles and responsibilities states that regional agencies should have authority over both land use and transportation planning and be required to develop a master plan for balanced transportation. The report further stipulates that such agency should have the power to require conformance to the regional plan and implementation program through project review, but would not have operating or regulatory authority. To date no TPA or regional planning agency, with the exceptions of MTC and the Tahoe Regional Planning Commission, possesses this power.

The state has assumed the responsibility of preparing a California Transportation Plan including corridor planning. AB69 requires that regional transportation plans be prepared by the TPA's and submitted to CALTRANS for review and incorporation into the State Plan as adopted by the State Transportation Board. The approach taken must be evaluated in terms of at least the following criteria: economic, land use, taxation, environmental, social and system performance, and level of service.

The State also has assumed the obligation and duty to coordinate and integrate multimodal transportation planning on a Statewide and interregional basis. In addition, the State has complete responsibility for planning, designing, constructing, operating, and maintaining the interregional highway system.

It is recognized by all concerned that land use policy authority is an issue of intense current debate nationally and statewide. Within this context of burgeoning efforts to increase the role of the state and of regional agencies, there is general agreement as expressed below:

- The regional transportation planning agencies (MTC, SRAPC, and SJCCOG) and CALTRANS express satisfaction with the existing distribution of land use authority and relationship to transportation at the interregional scale. The state looks to the regional planning agencies and city and county governments for land use decision-making that is coordinated with and supports interregional planning.

- Efforts to pass Federal and State land use legislation may culminate in the near future. If this occurs, policy-making and control over certain types of land use, including interregional plans and corridors may become a state responsibility. Any dissatisfaction with regional and local policies could result in further state legislation which would require local and regional conformance to interregional plans. Pertinent examples include AB2040 as proposed for the Bay Area and the authority of the Coastal Commissions.

- The concept of corridor management needs further amplification and analysis. At this moment, the concept is not fully understood nor has the feasibility or need been clearly demonstrated. Corridor planning and management may be expanded to include systematic multimodal transportation and land use planning as well as traffic and developmental monitoring to anticipate problems and arrange impact modifying controls. CALTRANS has prepared preliminary guidelines and issues for consideration of the State Transportation Board relating to the classification of all modes by level of significance and jurisdiction currently responsible for such facilities. State corridors will be defined under the same classification criteria. Land use controls are largely in the hands of local government. Large investments in new intercity systems suggest the need for close State-regional-local coordination to maximize the positive economic opportunities associated with access improvements and to minimize negative environmental or community disruption. State land use planning may also play an important role.

- AB69 is without reference to any CALTRANS responsibility for land use planning. Such authority has been discussed previously with the Westside Development Act which did contain provision for power initially, but was removed before adopted by law.

- Under AB69, CALTRANS is the only governmental jurisdiction that must comply with the California Transportation Plan following its formal adoption by the STB.

- Development of the California Transportation Plan is viewed as a participatory process with the State taking the leadership role in assuring that interregional transit planning occurs and that corridors are established. Corridor plans will become integral parts of regional plans.

Intermodal Coordination

One of the major problems to be faced by the interregional agency is the continuation of interregional traffic on an urban system and the interface among auto, bus, rail, and air travel systems. The benefits of State, Federal, or Regional investment in interregional transit that justify the investment would be lost if local feeder/distribution improvements were not made. Large public expenditures to achieve line-haul speeds superior to the automobile will not substantially improve service if local access includes a slow fixed route bus system with low headways and poor coverage. In addition, intermodal interface facilities (e.g., BART/Bus; Bus/Auto; Intercity Air System/Urban Transit System) are in most instances totally lacking or at best inadequate. With the installation of an interregional transportation service(s), high quality local transit and convenient intermodal interface facilities and transfers must be available if the potential benefits of such investments are to be realized. Certain state/regional or state/local quid pro quos may be necessary as a procondition to substantial state investments. For example, intermediate station stops might not be introduced until local and county authorities agreed to supply a certain level of local access supporting service.

The problem therefore includes three components--the need for planning and installing new local feeder/distribution service, the need for fixed capital improvements--e.g., terminals, cross-platform transfers, and park-ride lots--the need for a coordinated fare structure, collection, and transfer system. The Metropolitan Transportation Commission, for example, is attempting to develop a one-fare system throughout the Bay Area, possibly following the "transit federation" model. Discussions are underway for the creation of a voluntary transit federation for this purpose among the various transit operators that are within MTC's planning jurisdiction.

A similar approach among private transit companies has been functioning in Hamburg, Germany, since 1965 where eight independent operators

have formed a voluntary federation which has been the responsibility of planning networks, routes, and transfer points; the preparation of general schedules and equipment assignments; preparation of the joint tariff; calculating of operating costs and revenue redistribution for each company; and public relations.

The consensus relative to interface issues for intercity transit is summarized as follows:

- There should be established the decision-making capacity and professional expertise to accomplish the required interface facilities and procedures in conjunction with the regional operators. If this is not done, much of the convenience and attractiveness of the corridor system will be negated. As discussed in the technical sections of the alternative studies, the intercity systems are highly dependent on high quality, reliable, and closely coordinated local feeder/distribution systems.

- The question of how to handle transfers, marketing, distribution of funds, etc., should be approached through the regional federation process now being initiated in the Bay Area. The alternative would be some limited regulatory role for the Public Utilities Commission. In the event the local federation could not be made to function properly, then the State should intervene and assist in settling the issue. In other words, the State's role should be one of leadership and adjudication of disputes.

Priority and Programming

Except for the Metropolitan Transportation Commission, which has jurisdiction over State highways and BARTD, no transportation planning agency in the State has the power to compel compliance with the adopted regional plan. AB69 requires each regional transportation planning agency to make recommendations on regional relationships for consideration by CALTRANS, the legislature, and operating agencies. From these recommendations may come legislation providing for an orderly transition to a regional agency with sufficient power to implement the plan and program. However, this is not now CALTRANS or STB policy, and it leaves no clear division of decision-making authority between regional planning and operating entities for ensuring that transportation developments adhere to the areawide plan.

Again, AB69 seeks the voluntary cooperation of public transportation operating agencies by calling upon them to conduct their programs in accordance with the plans adopted by the regional planning agency. On the other hand, the regional transportation planning agencies already have a limited degree of control through the AB69 requirements for multimodal transportation plans and the related programs for capital improvements, operations, and funding through the Federal regulations which require the designated regional planning agencies to make A-95 and environmental impact reviews of projects proposed for federal funding by operating agencies. Regional agencies also control the allocation of the Local Transportation Fund on a county-by-county basis.

Areas of potential conflict between the state and regional and local agencies relative to the interregional system are:

- The issue of funding priorities between regional and interregional (statewide) projects constitute potential areas of conflict. For example, BART may feel that the extension of its system to the South Bay may have higher priority than expanding service to Sacramento. San Diego Corridor proposals may compete with the Sacramento Corridor.

- A similar issue probably will arise over the distribution of UMTA or SB325 funds among the various state regions that are pushing ahead with transit system plans.

- Another problem is the integration of feeder system construction with the interregional system. An example is provided by the fact that many airports are not being served adequately with ground transportation facilities. The state may be faced with the decision as to whether access facilities to the interregional system are properly a state responsibility.

Interjurisdictional Coordination

In view of the large number of organizational jurisdictions and overlapping responsibilities present in the corridor area, and the large sums of capital needed to finance public transportation projects, it is obvious that a statewide concern exists. This concern not only extends to resource allocations within the State and enforcing compliance with State plans, but also to a State oversight role.

Such a role was delineated in AB1727 (1973) whereby the Division of Mass Transportation of the Department of Transportation is authorized to review

the activities, plan, programs, expenditure, and priorities of the Southern California Rapid Transit District and other municipal operators in the area. In addition, the Joint Legislative Audit Committee of the Legislature may conduct an annual audit of receipts and expenditures of these agencies.

Consideration also should be given to the problem of interjurisdictional disputes over responsibilities, specific elements of plans, and extent of powers to be retained by any one agency. These conflicts are now apparent and exist between the State and the regional groups and between regional organizations.

It is generally concluded that:

- The State Legislature should and intends to take a strong role in transit planning. Ample evidence prevails in the public hearings being held throughout the State and the passage of AB1727 at the 1973 session.

- One aspect of this involvement is through the oversight authority to monitor and audit the use of funds and levels of performance, and the progress made in meeting EPA transportation control standards.

- The Legislature may eventually move to strengthen AB69 in terms of granting CALTRANS further responsibilities in resolving some of the interregional transit issues discussed herein.

- Are changes desirable in the State Transportation Board or should a "Transit Commission" similar to the current Highway Commission be created?

- Specific eminent domain powers-legislation is needed regarding property acquisition for interregional transit.

- An evaluation should be made of the existing process for resolving local conflicts on the Interstate and State Highway Systems. Does the freeway agreement furnish a model for application to corridor transit facilities? Is there a need for a parallel state/regional or interregional arrangement?

- Additional guidelines and procedures are needed to protect the integrity of the State plan where a change in level of service

occurs in one region--such as increased air terminal facilities for a certain type of service--that affects another region, for example, by inducing or reducing air traffic. There is a need for some type of mechanism or procedure that triggers a coordinated response from facilities or sources in one region when actions in another will affect it.

It is generally conceded that there is definitely a State role in planning, developing, and constructing an interregional transit system. The exact nature of that role will take quite different structures depending on the mode selected and the specifics of the situation. The organizational implications of the issues and findings set forth above, are discussed in the following section of this report.

ORGANIZATION

Given the substantial diversity of problems faced by the regions, metropolitan areas, and local units of government within the State and recognizing the number of organizations responsible for the delivery of transportation services, it becomes clear there is no prototype institutional arrangement which is necessarily applicable to each intercity corridor or interregional context. The fact that the CTP will encompass 41 regional plans each relating to local, regional, and statewide transportation facilities is illustrative of this multi-jurisdictional decision-making process.

Four major factors have a bearing on the determination of the best institutional arrangement for the Sacramento-Stockton-Bay Area interregional corridor:

- Which improvement program is deemed most appropriate for the corridor
- The extensiveness of the efforts required to plan, design, coordinate, operate, and maintain the selected program
- The capability of existing agencies to carry out these functions
- The political acceptability of alternative institutional arrangements

It should be noted that institutional arrangements appropriate to one function are not necessarily appropriate to another. For example, a single common institution might be appropriate to the planning for interregional transit regardless of technology while each individual technology (such as a BART extension or HSGT) may suggest different institutional arrangements for

design or operation depending on previous experience with that technology or operational problems. On the other hand, it is possible that all elements--system planning, project development and operations--could be assembled in one organizational entity if that proved to be necessary and desirable. A general analysis was made of alternative institutional arrangements in light of the capabilities required to implement an interregional transit system. The capabilities required, some of which will vary with the type of improvement selected, are:

- Legal authority and administrative, planning and engineering expertise
- Ability to generate, receive, and manage financial resources
- Transportation/land use coordination ability (interregional)
- State and regional plan coordination for issues of statewide significance
- Intergovernmental coordination through participation and resolution of supra-regional problems
- Citizen responsiveness
- Intermodal coordination and ability to supply interface elements
- Supra-regional programming authority on issues beyond regional significance or when regional conflicts exist
- Eminent domain power for transit
- Regulation of routes and schedules for interregional service through arrangements with PUC
- Oversight and review of multijurisdictional and intergovernmental problems above the regional level

The alternative organizational arrangement or agencies investigated to provide these capabilities and to carry out the system planning and program, project design and implementation, and system operation elements associated with the various transit improvements, consisted of:

- Continue Study Consortium
- New Corridor TPA or expanding existing TPA such as MTC
- CALTRANS
- A new regional district such as BARTD or OCTD
- Expansion of the authority of an existing district such as BARTD
- Public corporation such as Port Authorities, Amtrak
- Private sector such as Greyhound or Southern Pacific
- Federal government (only insofar as Amtrak and the regulation of air carriers and airspace is concerned)

Based upon this analysis and the reactions of the Steering Committee to the results presented in "Intercity Public Transportation-Institutions, Funding, and Implementation," it is possible to delineate a number of areas in which a consensus was manifested.

System Planning

In terms of jurisdiction of professional expertise, of financial capability, or regulatory authority, CALTRANS has clear strengths compared to the other alternative organizations. However, with respect to intergovernmental input and citizen responsiveness, the advantage seems to accrue to a new corridor transportation planning agency modeled on the current study consortium. The prime advantage of this approach is that the regional agencies have planning jurisdiction over the large concentrations of population in the three metropolitan areas and consequently are responsible for finding solutions to the bulk of the transportation problems. Further, they are very much involved in the interface problem, namely, transfer of passengers from the corridor facility to another operator or to a terminal facility. Finally, they are also closer to the local policy, land use, development, and environmental questions, which are part of the transportation planning context.

The conclusions with regard to system planning and programming functions associated with the alternative interregional transit improvement programs were:

- Interregional System Planning and programming is an appropriate state role and the present study consortium approach with the appropriate metropolitan areas is deemed to be an appropriate mechanism for assuring intergovernmental input and participation.

- In terms of areal coverage, professional and technical expertise, financial capability, transportation/ land use relationships, State plan coordination (all modes), program authority, regulatory capacity, resource allocation, and oversight responsibility, CALTRANS appears to have a substantial net advantage over the other alternative organizations investigated.

- CALTRANS would have to increase its capability in public transportation planning if it were to assume this responsibility.

- To avoid the possibility of downgrading of the planning function, planning should not be combined with operations.

<u>Project Development</u>

The project planning and development function appears to be a logical duty of either CALTRANS, a new special district or public corporation, or of an existing transit district. CALTRANS, for instance, developed an outstanding group of engineers during the period of accelerated freeway planning, designing and construction. CALTRANS can provide expertise in setting priorities, allocating resources, right-of-way acquisition, supervising construction, setting uniform design standards, planning and modeling techniques, and contract administration.

Project design and development capability are related to the mode involved. The skills required in one mode are not readily transferable to another. In addition, there are significant differences in the capabilities required for guideway construction as compared to station design, propulsion, and control systems and related subsystems. CALTRANS has had little experience in this area. The relationship between the public and private sector responsibility must therefore be carefully considered.

<u>System Operation and Maintenance</u>

There are a number of general ways the system operation and maintenance--the operating function can be conducted: direct management of the operating facilities by the organization responsible for the service; purchase of equipment and leasing to a private or other public operator; purchase of service agreements whereby the responsible governmental agency or affected unit of government (cities and counties) contracts with a transit operator, usually private, for a prescribed level of service; and franchise agreements underwriting a specified level of income or profit.

Whereas CALTRANS ranks high in capability for system planning, relatively high in public transportation project development, and high in highway project development, it has little or no experience in operating airways, airports, bus, or rail systems. Among existing transit districts, Alameda-Contra Costa Transit District has operated buses in the East Bay Area for many years, and the Golden Gate Transportation District is a recent entry in the field, however, the prime orientation is toward the provision of intra-urban service. Major nationwide firms--bus companies and airlines--also have many years experience in operating intercity transportation services. The Federal Government's role in passenger transportation is limited to the Amtrak type of operation--not as a direct operator, but in the form of a provider of equipment and purchaser of services. BART and the Sacramento Regional Transit District are examples of existing transit districts that have developed a high level of experience and expertise providing transit services.

Based on these general observations, it is concluded that:

- Given the probability that the operation of a traditional mode would be implemented through a contractual arrangement with existing operators such as Greyhound, BART, or AMTRAK, the consensus was to locate the operational responsibility with the State.
- Consideration should be given to forming a new unit within the State structure to undertake this operational authority.
- If the HSGT system is selected, a special State agency corporation with authority for both project design and system operation, similar to BART, would probably be required.

System Financing

There is an inevitable relationship between institutional arrangements for planning, construction and operating a public service and the profitability and source of financial support for that service, Institutional responsibilities must, therefore, be considered in the light of the potential financial requirement of the particular mode of interest. It is not likely that highly competitive intercity transit systems can be developed without the expenditure of large sums of money. Initial stages, however, may be relatively modest as the market is tested. A proposed constitutional amendment, SCA15, will permit State highway user taxes to be used in building fixed facilities associated with public transportation sytems and associated environmental impact reduction measures. County or area voter authorization is required. In addition, the Legislature may authorize use of the monies for voter approved

projects relating to transit. This amendment is supported by the STB and CALTRANS. It is not clear at present what funds will be available after statewide maintenance, county highway-related minimums, and other committed programs are subtracted.

In terms of operating costs, the present analysis has not yet determined the liklihood that the systems under review can be free of deficits. Some alternatives (improved passenger train, BART Continuation and TACV) require large capital investments in hardware, land, construction, and terminals. Under existing statutes, there is no way to provide direct public support for intercity systems (indirect support is available through AMTRAK legislation). Operating assistance is another potential financial issue. Consideration must be given to ways in which current Federal and State programs and resources can be used and how new sources of funds can be developed.

Appendix A attached, outlines the relevant portions of the Federal Highway, Transit and Airport assistance programs. While certain portions of the corridor might be eligible to use the programs in financing part of an inter-regional system, it seems apparent that this would cut into the already inadequate supply and arouse the opposition of the regions, counties and local governments within the study area. (The exception to this is use of the Airport and Airways Development Act.) Other means of raising revenue for urban transit, set up by various states around the nation, include special purpose districts or alternatives with bonding or taxing authority.

In California, subsidies are available for both operating and capital expenditure. Nonrevenue sources are also used for this purpose in several states. In each case, however, the authorizations are directed towards urban transit. This is reviewed in Appendix A.

It is evident that the State must inevitably play a large role in the development of financial support for interregional transit:

- As the receiver or transmitter (pass through) of federal sources as applicable or if new programs are developed

- As the initiator through legislation of a new instrumentality with statewide or interregional corridor authority to raise or receive funds

In either case, the legislature and CALTRANS together must develop the most promissory approach. Given the scale of the corridors and interjurisdictional problems, a statewide instrumentality such as CALTRANS may be the most promising vehicle.

Institutional Arrangements

The material which follows suggests specific institutional arrangements necessary to implement express bus, rail, BART and new high speed ground improvements . The role of CALTRANS and other institutions or private operators to which CALTRANS must relate are suggested.

Bus

Perhaps the most expeditious and financially feasible modal system for the corridor is to upgrade existing facilities. By choosing to improve the present level of bus service furnished by private bus companies (largely Greyhound), it would be unnecessary to create a new operating entity. Three levels of involvement are possible. The minimal role would be an "advisory planning" function. If given this responsibility by the Legislature, CALTRANS could:

- Perform market survey
- Carry out demand projections
- Design new routes and stops
- Suggest changes in terminals

Working with local transit operators and regional and county planning agencies through an "intercity transit planning group," CALTRANS could perform a leadership role in lobbying for more effective intermodal interface with intercity transit. In this role, CALTRANS would be in a position to offer advice, assistance and encouragement to Greyhound. However, this role also has certain practical limitations. Control over routes, fares, and schedules is now exercised by another state agency--the State Public Utilities Commission following its jurisdiction under the State Constitution. Its role already covers certain aspects of this minimal planning function. The PUC regulates all commercial vehicles, including common carriers, as business affected with the "public interest." Private bus operators, such as Greyhound, operating scheduled service between fixed terminals over a regular route outside local jurisdiction come under its regulation.

This regulation is outlined in the Public Utilities Code which outlines a broad, but general mandate covering all service for the public convenience and necessity. The PUC maintains a level of service that must be "just and reasonable". It grants and reviews franchises, regulates competition, and in general prescribes rules of performance, including additional service.

Through both formal hearings and informal administrative activities, the PUC attempts to respond to a request for change, increase, or decrease in service and fares. An application or complaint can be brought to the PUC through a petition process--such as a request for new service by

a potential user group or an application for rate increase by an operator. These are either resolved administratively by the PUC through a resolution or an ex parte decision without a hearing or handled through a formal hearing procedure.

"Determination of 'just and reasonable' lies with the appointed Commission, with an applicant having the right of judicial appeal to the State Supreme Court if it feels a Commission decision is confiscatory."

In cases of petitions for new service, a test period is generally agreed upon by the utility (bus operator) and the Commission staff with ground rules as to what constitutes conditions justifying continued service based on a judgment balancing the public interest of the petitioner against the general economic health of the operator. While the PUC staff does not engage in transportation planning in a formal sense, often a case is brought by the PUC staff itself based on its own research. PUC staff maintains contact with regional transportation planning and urban transit operations. In other cases, any group with standing can petition. One recent case was a group of state employees, whose office was moved from the East Bay to Sacramento, suggesting the need for special service. This type of function could be jointly exercised by PUC and CALTRANS with the assistance of technical studies carried out by CALTRANS.

It is not clear that a private operator can be expected to take special risks or accept reduced returns in the "public interest". If there is a public decision to initiate new service between two points to serve a need that is not seen as a significant "market" by the private operator, there must be a mechanism to bridge this gap between the private market and the public policy. One option is to let the bus operators' fare reflect the market it attracts, although this may defeat the public purpose. Another is to institute the service and subsidize operating costs incurred for service operating with less than a certain specified load factor. There is a limited precedent for this approach. Already PUC fare regulations result in some of the more lucrative long-distance routes in California, in effect subsidizing the less efficient routes, such as commuter operations. Purchase-of-service agreements are an alternative approach to guaranteeing a given service level. Each of these approaches assumes that the benefits of the service are not expressed in fare box terms. A fourth option, along the Public Utilities Commission model, is to negotiate a trial period under joint supervision and drop the experiment if patronage does not develop.

In many cases, effective marketing and improved bus image can generate increased ridership. It is clear that current bus service is not tapping many markets. Nonethless, viewing intercity transit as a public utility raises questions similar to those faced during the public takeover of the private urban transit operators.

Clearly new mechanism would be needed for defining and initiating new service. This implies the need for a new arrangement between institutions representing public service and the private operator with a possible sharing of the risks of new service. The present PUC role is largely a passive one--reacting to fare or service change petitions from the operator or organized groups. They seldom identify needed new service. In addition, they do not pursue their jurisdiction in respect to terminal facilities (the environment of which is one of the major impediments to attracting the market), intermodal issues, marketing, etc.

The second level of CALTRANS involvement would require financial resources such as those identified in SCA 15. Capital funds for fixed facilities would give CALTRANS the ability to develop new intermodal transfer-oriented terminal facilities for intercity buses. Relatively small capital intensive improvements would include:

- New class-platform bus terminals at appropriate BART stations
- Union bus terminals in downtowns
- Highway interchange "bus pads"
- Direct bus-only highway access ramps from pads and terminals
- Special bus lanes if necessary

The ownership and management of the bus service would remain a private operation. Terminals and other facilities noted above would be financed and constructed by the state and leased to the private operator. Greyhound has expressed an interest in such an arrangement.

A third level of state involvement in intercity bus service involves state establishment and maintenance of an improved level of intercity bus service (routes and schedules) as a public responsibility. Under this approach increased service under state-sponsorship could involve the problem of the need for state investment in vehicles as well as fixed facilities. State-owned equipment could be operated by the private operator under a lease-lease-back arrangement such as currently used in commuter-rail operations in the East.

Finally, state interest in feeder service at intermediate stations suggests the possibility of state-sponsored dial-a-bus systems, serving the line-haul express buses. Capital funds, state and federal, are currently available for such services. The need for joint or reduced fares may also introduce the question for operating subisides.

Rail

Section 403 of the Legislation establishing the National Railroad Passenger Corporation (Amtrak) states that any state or region may request new passenger service from Amtrak. Upon agreement that the state will bear two-thirds of the operating deficits and associated capital costs, Amtrak "shall institute such services". The remaining one-third would be financed through Amtrak funds--increased in 1973 legislation with $154 million available in unappropriated authorizations and a loan guarantee authority of $500 million.

This approach would require that the Legislature delegate the responsibility for intercity rail passenger service to an existing (CALTRANS) or new state agency. The required function of this new institution would be basic planning. Under the cost reimbursement provision of the Amtrak Law, the State must also be in a position to finance two-thirds of the expected losses. State legislation sponsoring intercity rail transit must, therefore, designate or provide for a source of funds.

The State would then be in a position to contract with Amtrak for the new service on routes and schedules as desired. Both the Southern Pacific and Santa Fe are partners to the basic agreement with Amtrak and are, in theory, obligated to run such service as requested by Amtrak in return for having been relieved of certain passenger service obligations at the time of the 1970 Amtrak legislation. Ordinarily, Amtrak would provide the equipment and service personnel and reimburse the private railroad for operating personnel. The State's function would be to define and request service and meet the financial obligations incurred for operating losses.

As a practical matter, there are several problems to be overcome in establishing new service:

- Operational Problems--The mixing of existing freight and new passenger traffic on common tracks constitutes an operating problem to a private railroad attempting to maintain an efficient freight service. While passenger trains "must be accorded preference over freight trains", operational conflicts must be resolved in a manner which does not materially lessen the quality of freight service to shippers and recognizes operating and safety standards. The final decision would be made following arbitration by the U.S. Secretary of Transportation. The results of such conflicts may require capital investments in train controls or new track to accommodate passenger service. If defined as "avoidable costs" through arbitration, they would have to be borne by Amtrak and the state.

- Level of Service--Under 1973 legislation, passenger trains are to be given preference within reasonable conditions. In

addition, if a railroad refuses to permit speeds above its own train order speed limits (70 mph between Oakland and San Francisco), Amtrak may apply to the Secretary of U.S. DOT for a hearing and findings. If grade crossing improvements are required, both federal and state funds are available.

- Track Condition--90 mph passenger service may require track upgrading in terms of rail and track bed conditions, super elevation, etc. These physical parameters are currently designed for minimum maintenance on-balance freight operations. Either Amtrak and the State must bear these costs alone, or the railroad may be required to share the costs. Arbitration may be used to resolve mutual responsibilities.

- Availability of Equipment--Amtrak is making heavy utilization of the equipment it owns as well as purchasing new equipment. Depending on the nationwide demand, additional equipment may be required. This could be achieved in one of three ways:

  -- Amtrak buys and cost is included in total cost of service to be shared.

  -- State buys and cost is deducted from state contribution to deficit support.

  -- Private corporation buys and leases to Amtrak.

Purchase of new equipment raises the possibility of using more advanced vehicles such as the United Aircraft or French TGV trains.

It can be expected that in the event of state and Amtrak desire to institute new service under Amtrak authority, the subjecting conditions of Amtrak legislation and due regard for the railroads' physical and financial condition will require negotiated and perhaps arbitrated settlements. The state PUC has jurisdiction over certain intrastate routes not included in the Amtrak system and CALTRANS can petition PUC for new service. If necessary, the Amtrak system could be supplemented by the purchase of service agreements by private bus companies.

An alternative approach would be the formation of a State Transit Corporation (CALTRAK) which could receive federal funds, issue bonds, purchase or lease equipment and contract with private railroads for operational personnel. The major impediment to this approach would be lack of operating rights which Amtrak now possesses.

BART

The construction of a rail guideway to interconnect with the BART system provides another modal option that could be implemented with minimal institutional modifications. This alternative would possess the following organizational features:

- Given this option, the state role would be to plan and finance the proposed system. Project design and development could be undertaken with consultant assistance on systems engineering. Operations would either be assigned by the Legislature to BART or the state could contract with BART to operate and manage the equipment and facilities provided by the state.

- Within the state administration, it would be essential for the Legislature to designate an existing or new organizational entity to perform the functions stated above.

- Many new skills and staff personnel would be needed since the state has had no experience with rail transit planning and development. Assuming the operational function was delegated to BART, the state would still require special professionals trained in transit management to oversee and monitor either the purchase-of-service agreement or the performance of BART if given this function by the Legislature.

High Speed Ground (New Technology)

As a new technology, it is possible that implementation of a Tracked-Air Cushion Vehicle system would be a federal or state "Demonstration Program". Implementation will be a high risk situation in terms of the vehicle and power source requiring close monitoring and extensive testing.

The institutional approach varies from the BART extension option in that the new interregional transit system would be owned and operated by a special district or authority created for this purpose. Essentially, it would have the following conditions surrounding it:

- The State's role under this concept would be to create the new institution and endow it with the necessary powers and duties.

- The State Legislature would be particularly concerned with delegation of the oversight responsibility and the planning

and project development capability. Presumably, the State would retain these duties. The Legislature's experience with BART and the Southern California Rapid District would no doubt influence actions in this regard.

- If this alternative mode were selected, the State should give consideration to the possibility of a statewide corridor mass transit system. In this event the development of a state "comsat-type" entity to be responsible for such a system would seem to have merit.

- A new institution would require a significant lead time in developing a professional staff and general organization to carry out its role.

- A new institution may encounter more financial problems than would the state government. Since the obtaining of adequate financial support is mandatory, the State must provide substantial sources of revenue and bonding capabilities.

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